

AD-A242 521

AD-A242 521



ESL-TR-89-15
VOL 1

Um (2)

ENVIRONMENTAL PROTECTION FOR
HAZARDOUS MATERIALS INCIDENTS,
VOLUME 1, HAZARDOUS MATERIALS IN-
CIDENT MANAGEMENT SYSTEM

B. D. BARKENBUS, R. J. CARTER, J.E. DOBSON,
C. E. EASTERLY, P. S. OGLE, A. K. VANCELEAVE

OAK RIDGE NATIONAL LABORATORY
US DEPARTMENT OF ENERGY
OAK RIDGE TN 37831

NOVEMBER 1990

FINAL REPORT

OCTOBER 1986 - JUNE 1990

DTIC
ELECTE
OCT 31 1991
S C D

20030220190

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION
UNLIMITED

91-14393



AFESC

AIR FORCE ENGINEERING & SERVICES CENTER
ENGINEERING & SERVICES LABORATORY
TYNDALL AIR FORCE BASE, FLORIDA 32403

91 10 29 001

NOTICE

PLEASE DO NOT REQUEST COPIES OF THIS REPORT FROM
HQ AFESC/RD (ENGINEERING AND SERVICES LABORATORY).
ADDITIONAL COPIES MAY BE PURCHASED FROM:

NATIONAL TECHNICAL INFORMATION SERVICE
5285 PORT ROYAL ROAD
SPRINGFIELD, VIRGINIA 22161

FEDERAL GOVERNMENT AGENCIES AND THEIR CONTRACTORS
REGISTERED WITH DEFENSE TECHNICAL INFORMATION CENTER
SHOULD DIRECT REQUESTS FOR COPIES OF THIS REPORT TO:

DEFENSE TECHNICAL INFORMATION CENTER
CAMERON STATION
ALEXANDRIA, VIRGINIA 22314

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT DISTRIBUTION LIMITED. RELEASABLE TO NATIONAL TECHNICAL INFORMATION SERVICE		
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) VOLUME I OF III			5. MONITORING ORGANIZATION REPORT NUMBER(S) ESL-TR-89-15		
6a. NAME OF PERFORMING ORGANIZATION OAK RIDGE NATIONAL LABORATORY US DEPARTMENT OF ENERGY		6b. OFFICE SYMBOL (If applicable) ORNL	7a. NAME OF MONITORING ORGANIZATION ENGINEERING AND SERVICES LABORATORY		
6c. ADDRESS (City, State, and ZIP Code) OAK RIDGE, TENNESSEE 37831			7b. ADDRESS (City, State, and ZIP Code) AIR FORCE ENGINEERING & SERVICES CENTER TYNDALL AIR FORCE BASE, FLORIDA 32403-6001		
8a. NAME OF FUNDING/SPONSORING ORGANIZATION HQ AFESC/RD		8b. OFFICE SYMBOL (If applicable) RDCF	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER CONTRACT NO. DE-AC05-840421400		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO. 64708F	PROJECT NO. 2505	TASK NO. 20
					WORK UNIT ACCESSION NO. 11
11. TITLE (Include Security Classification) ENVIRONMENTAL PROTECTION FOR HAZARDOUS MATERIALS INCIDENTS, VOLUMES I, II					
12. PERSONAL AUTHOR(S) B. D. BARKENBUS, R. J. CARTER, J. E. DOBSON, C. E. EASTERLY, P. S. OGLE, AND A. K. VANCLEAVE					
13a. TYPE OF REPORT FINAL REPORT		13b. TIME COVERED FROM 1OCT86 TO 1JUN90		14. DATE OF REPORT (Year, Month, Day) JUN 90	
				15. PAGE COUNT 349	
16. SUPPLEMENTARY NOTATION THIS REPORT IS IN THREE VOLUMES: I-HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM, II-APPENDICES, III-GUIDE BOOK					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD GROUP SUB-GROUP					
15 02			HAZMAT, Hazardous Materials, Incident Management		
15 02					
19. ABSTRACT (Continue on reverse if necessary and identify by block number) During the past decade, chemical exposures have become recognized for the potential hazards they actually represent. Before that time, proper caution had not been acknowledged as to inadvertent or even planned exposure regarding hazardous chemicals. The objective of this effort was to define and identify a computer system for Air Force fire departments that would facilitate hazards assessment and response during HAZMAT emergencies, provide HAZMAT incident management guidelines, and provide a training tool to simulated emergency response. Volume I contains the HAZMAT Incident Management System, Volume II is an Appendices of the HAZMAT data collected and Volume III is a Hazardous Materials Incident Management System (HMIMS) Guide Book.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a. NAME OF RESPONSIBLE INDIVIDUAL CHARLES W. RISINGER			22b. TELEPHONE (Include Area Code) (904) 283-3734		22c. OFFICE SYMBOL RDCF

PREFACE

This task report was prepared by the Oak Ridge National Laboratory, US Department of Energy, under Contract DE-AC05-84OR21400, with the Headquarters Air Force Engineering and Services Center, Tyndall Air Force Base, Florida 32403-6001. This report summarizes the work done between 1 October 1989 and 1 June 1990. Mr Charles W. Risinger was the Laboratory Project Officer. The authors acknowledge the support and assistance provided by the following individuals: B. D. Barkenbus, R. J. Carter, J. E. Dobson, C. E. Easterly, P. S. Ogle, and A. K. VanCleave, members of the HAZWARP Support Contractor Office, operated by Martin-Marietta Energy Systems, Inc., at Oak Ridge, Tennessee 37831.

This report is in three volumes. Volume I contains the Hazardous Materials Incident Management System (HMIMS), Volume II is an Appendices of the HAZMAT data collected and Volume III is the guide book to implement HMIMS.

This report has been reviewed by the Public Affairs Office. Distribution limited to DOD and DOD contractors only; this report documents test and evaluation; distribution limitations applied October 1986. Other requests for this document must be referred to the Air Force Engineering and Services Center (AFESC/RDXI), Tyndall Air Force Base, Florida 32403-6001.

Portions in Volume III of this report (identified by the designation proprietary) contain data furnished to the U.S. Government as Limited Rights Data pursuant to DAR Clause 7-104.9, and Contract No. DE-AC05-340421400.

This technical report has been reviewed and is approved for publication.

Charles W. Risinger
CHARLES W. RISINGER
Project Officer

Felix T. Uhlir III
FELIX T. UHLIR III, Lt Col, USAF
Chief, Engineering Research Division

Joseph L. Walker
JOSEPH L. WALKER
Chief, Air Base Protection and
Crash Rescue System Branch

Frank P. Gallagher III
FRANK P. GALLAGHER III, Colonel, USAF
Director, Engineering and services
Laboratory

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or
A-1	Special

TABLE OF CONTENTS

Section	Title	Page
I	INTRODUCTION.....	1
	A. OBJECTIVE.....	1
	B. BACKGROUND.....	1
	C. SCOPE.....	2
II	EXTENT OF THE HAZARDOUS MATERIAL (HAZMAT) PROBLEM AT SELECTED AIR FORCE BASES.....	4
	A. INTRODUCTION.....	4
	B. AVAILABILITY OF HAZMAT INFORMATION FOR FIRE DEPARTMENTS.....	4
	1. Base Supply.....	6
	2. Transportation.....	7
	3. Waste.....	7
	4. Department of Defense HAZMAT Information System.....	8
	5. Fire Department HAZMAT Inventory List.....	9
	6. HAZMAT Inventory List for Aerospace Vehicles....	17
	7. Base Specific HAZMAT Information Systems.....	17
	C. HAZMATs IDENTIFIED DURING INSTALLATION RESTORA- TION PROGRAM.....	19
	1. Chemical Inventory.....	19
	2. Interaction of Fire Departments with the Installation Restoration Program.....	22
	D. AVAILABILITY AND SOURCES OF HAZMAT INFORMATION FOR HAZMAT TRANSPORTED WITH AIR FORCE AND CONTRACTOR-OPERATED MOTOR, RAILROAD, AND AEROSPACE VEHICLES.....	22
	1. Motor Vehicles.....	23
	2. Railroad Vehicles.....	27
	3. Aerospace Vehicles.....	28
	4. Hazardous Waste and Transport.....	28
	5. Cargo Movement Operations System.....	31
	E. HAZMATs CLASSIFICATION SYSTEMS.....	31
	1. Air Force HAZMAT Classification System.....	31
	2. Other Classification Systems.....	35

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
	2. EXISTING INTERFACE BETWEEN THE USERS AND THE RESPONDING ACTION AGENCIES AT HAZMAT EMERGENCIES.....	45
	1. Relevant Literature.....	45
	2. Spill Prevention Response (SPR) Plans, Spill Committees, and Disaster Preparedness Operations (DPO) Plans.....	52
	3. Interface During HAZMAT Emergencies.....	75
	4. Other Information Obtained from Visits to Fire Departments.....	78
	3. INFORMATION ON HAZMAT-RELATED HARDWARE AND SOFTWARE.....	86
	1. Computer Hardware and Software at Air Force Bases.....	86
	2. Computer Hardware and Software in Selected Cities.....	88
	4. TOXIC MATERIALS TRANSPORT MODELS AND SOURCES OF METEOROLOGICAL DATA.....	91
	1. Types of Atmospheric Transport Models....	91
	2. Sources of Meteorological Data.....	94
III	AIR FORCE FIRE DEPARTMENT HAZMAT INCIDENT MANAGEMENT PLANS.....	95
	A. INTRODUCTION.....	95
	B. AREAS OF RESPONSIBILITY AND ROLES FOR RESPONSE AGENCIES.....	95
	1. Fire Department.....	96
	2. On-Scene Commander.....	97
	3. Security Police.....	98
	4. Civil Engineering.....	98
	5. Bioenvironmental Engineer.....	99
	6. Public Affairs Office.....	99
	7. Base Medical Treatment Facility.....	100
	8. Transportation Squadron.....	100
	9. Weather Squadron.....	100
	10. Disaster Preparedness Office.....	100
	11. User Activity.....	100

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
C.	REQUIREMENTS FOR PERSONNEL TO HANDLE HAZMAT INCIDENTS.....	101
	1. Fire Department Personnel Requirements.....	101
	2. Requirements for a HAZMAT Van and Additional Personnel.....	102
	3. Personnel Requirements for Other Agencies.....	103
D.	PROCEDURES FOR RECOGNIZING, STABILIZING, CONTROLLING AND CLEANING UP OF HAZMAT INCIDENTS.....	104
	1. Definition of Terms.....	104
	2. Fire Department Duties During HAZMAT Incidents.....	106
	3. Procedures to Recognize the HAZMAT Involved.....	106
	4. Procedures to Control/Contain the Spill.....	109
	5. Procedures to Stabilize the Spill.....	116
	6. Installation Restoration Program.....	116
E.	PROCEDURES FOR DECONTAMINATION.....	117
	1. Decontamination Officer.....	118
	2. Decontamination Group Personnel.....	126
F.	PERSONNEL EVACUATION.....	130
	1. Isolation and Evacuation Information from Site Visits to Air Force Fire Departments.....	131
	2. Isolation and Evacuation Guidance from the Environmental Protection Agency, Department of Transportation and the National Oceanic and Atmospheric Administration.....	132
	3. Evacuation Issues.....	136
	4. Vulnerable Zones and Toxic Plume Models.....	140
	5. Decision-Making Criteria for Personnel Evacuation.....	141
	6. Evacuation Decision-Making Checklist.....	148
G.	POSTINCIDENT EVALUATION AND FEEDBACK.....	149
	1. Evaluation Procedures.....	149
	2. Feedback Process.....	151
	3. Checklists.....	153
	4. Formalization of the Review and Feedback Process.....	194

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
H.	BIOENVIRONMENTAL ENGINEERING/MEDICAL EVALUATION RESPONSIBILITIES ASSOCIATED WITH HAZMAT INCIDENTS.....	194
1.	Overview.....	194
2.	Bioenvironmental Engineering/Medical Activities Before a HAZMAT Incident.....	195
3.	Bioenvironmental Engineering/Medical Response During a HAZMAT Incident.....	199
4.	Critique on the Support Role of Bioenvironmental Engineering/Medical Response to the Fire Departments at HAZMAT Incidents.....	201
I.	EMERGENCY RESPONSE PERSONNEL PARTICIPATION IN INSTALLATION RESTORATION PROGRAM CONTRACT DEVELOPMENT AND ASSOCIATED HEALTH AND SAFETY PLANS.....	203
1.	Installation Restoration Program Contractors and Their Health and Safety Programs.....	204
2.	Interaction of AF Emergency Response Personnel with Installation Restoration Program Activities.....	206
J.	HAZMAT INVENTORY REQUIREMENTS AND OPTIONS FOR IMPLEMENTATION.....	207
1.	Background.....	207
2.	Options for Inventory Development.....	208
K.	PERSONAL PROTECTIVE CLOTHING, EQUIPMENT, AND MATERIALS TO HANDLE HAZMAT INCIDENTS.....	213
1.	Chemical Protective Clothing and Levels of Protection.....	213
2.	The Chemical Protective Clothing Selection Process.....	216
3.	Base HAZMAT Assessment.....	216
4.	Base Specific Chemical Protective Clothing Inventory Selection.....	217

TABLE OF CONTENTS
(CONTINUED)

Section	Title	Page
	5. Chemical Protective Clothing Selection Factors.....	218
	6. Selected Chemical Protective Clothing Types....	221
	7. Chemical Protective Clothing Selection Logic.....	225
	8. Respirators.....	227
	9. Gloves.....	228
	10. Footwear.....	231
	11. Chemical Protective Clothing Regulations.....	231
	12. HAZMAT Response Equipment.....	232
	13. HAZMAT Response Chemicals.....	237
L.	NATIONAL STOCK NUMBERS FOR EQUIPMENT, MATERIALS, AND CLOTHING FOR HAZMAT INCIDENTS.....	239
M.	MUTUAL AID REQUIREMENTS AND RESPONSE AGENCY ACTIONS.....	240
	1. Federal Regulations that Pertain to HAZMAT Contingency Requirements.....	240
	2. Air Force Regulations Pertaining to HAZMAT Contingency Requirements.....	244
	3. Mutual Aid Requirements for Contingency Agreements.....	245
	4. Response Agency Actions Pertaining to Initiation and Participation in Mutual Aid Agreements.....	247
IV	AIR FORCE HAZARDOUS MATERIALS RESPONSE TRAINING NEEDS FOR FIRE PROTECTION PERSONNEL.....	249
A.	INTRODUCTION.....	249
	1. Laws and Regulations.....	249
	2. Overview of this Section.....	250
B.	MINIMUM TRAINING REQUIREMENTS FOR FIREFIGHTERS FOR HAZMAT RESPONSE.....	251
	1. Levels of HAZMAT Response Training.....	251
	2. First Responder, Awareness (FRA) Level.....	252
	3. First Responder, Operational (FRO) Level.....	255
	4. Hazardous Materials Technician (HMT) Level.....	260
	5. Hazardous Materials Specialist (HMS) Level.....	269

TABLE OF CONTENTS
(CONCLUDED)

Section	Title	Page
C.	HAZMAT TRAINING COURSES AND THEIR SOURCES.....	277
D.	CRITERIA FOR CERTIFICATION OF RESPONSE PERSONNEL....	279
	1. Overview of the Certification Process.....	279
	2. Criteria for First Responder Awareness Level.....	281
	3. Criteria for First Responder Operational Level.....	285
	4. Criteria for Hazardous Materials Technician Level.....	292
	5. Criteria for Hazardous Materials Specialist Level.....	299
	6. Listing of Possible Local Criteria for Certification of Responders.....	304
E.	TRAINING COURSE OUTLINES FOR HAZMAT RESPONDERS.....	306
	1. First Responder, Awareness Level.....	306
	2. First Responder, Operational Level.....	307
	3. Hazardous Materials Technician Level.....	310
	4. Hazardous Materials Specialist Level.....	312
V	HAZARDOUS MATERIAL INCIDENT MANAGEMENT SYSTEM.....	314
A.	INTRODUCTION.....	314
B.	JUSTIFICATION.....	314
C.	FUNCTIONAL REQUIREMENTS FOR HAZMAT INFORMATION MANAGEMENT SYSTEM.....	315
D.	SOFTWARE SELECTION.....	317
	1. HAZMAT Data Bases.....	317
	2. Inventory Data Bases.....	323
	3. Emergency Management Systems.....	323
	4. Geographic Information Systems.....	324
	5. Air Diffusion Models.....	324
	6. Graphic Systems.....	325
	7. Evaluation and Selection.....	325
E.	HAZARDOUS MATERIAL INCIDENT MANAGEMENT SYSTEM DEVELOPMENT.....	326
VI	CONCLUSIONS.....	329

TABLE OF CONTENTS
(CONCLUDED)

Section	Title	Page
VII	RECOMMENDATIONS.....	333
	REFERENCES	341
	BIBLIOGRAPHY	345

LIST OF FIGURES

Figure	Title	Page
1	DOT Hazardous Materials Warning Labels.....	24
2	DOT Hazardous Materials Warning Placards.....	25
3	Form DD-1348-1, a DOD Single Item Release Document.....	29
4	EPA's Uniform Hazardous Waste Manifest.....	30
5	Tinker AF Base Bioenvironmental Engineering Flow Sheet for Classifying Hazardous Materials.....	34
6	Hazard Rating Scheme of the National Fire Protection Association.....	40
7	Four Hazard Indicators.....	43
8	Spill Reporting Center Log Sheet.....	48
9	Recommended Initial Spill Response and Notification Procedures in the <u>Guidance Manual</u> by Engineering- Science, Inc.....	49
10	Hazardous Materials Data Sheet.....	55
11	Sample Hazardous Substance Information Form.....	56
12	Incident Exposure Record.....	59
13	Tinker AFB HAZMAT Incident Command System.....	69
14	Hazardous Material Incident Checklist.....	72
15	Hazardous Material Worksheet.....	74
16	Andrews AFB HAZMAT Emergency Response Team.....	76
17	Edwards AFB HAZMAT Emergency Response Team.....	77
18	Hanscom AFB HAZMAT Emergency Response Team.....	79
19	AF Form 1028, Facility Prefire Plans.....	83
20	CAMEO Components.....	89
21	Respirator Selection Logic Diagram	229

LIST OF TABLES

Table	Title	Page
1	Hazardous Materials Issue Report, Eglin Air Force Base.....	10
2	Air Force Installation Restoration Program Toxicology Guide.....	20
3	Explanation of National Fire Protection Association Hazard Classifications.....	39
4	Planning Guide for Determining Response Levels.....	152
5	Software Systems Evaluated for Hazardous Materials Incident Management System.....	313
6	Information on Software Systems Evaluated for Hazardous Materials Incident Management System.....	319

LIST OF ACRONYMS

AAR	American Association of Railroads
AF	Air Force
AFB	Air Force Base
AFESC	Air Force Engineering and Services Center
AFGL	Air Force Geophysics Laboratory
AFLC	Air Force Logistics Command
AFOSH	Air Force Occupational Safety and Health
AFR	Air Force Regulation
AFTOX	Air Force Toxic Chemical Dispersion Model
AMP	Aerospace Medicine Program
ANSI	American National Standards Institute
BCE	Base Civil Engineer
BCP	Base Comprehensive Plan
BEC	Base Environmental Coordinator
BEE	Bioenvironmental Engineer/Bioenvironmental Engineering Services
BHA	Base HAZMAT Assessment
CAA	Clean Air Act
CAD	Computer-Aided Dispatch
CAMEO	Computer-Aided Management of Emergency Operations
CDROM	Compact Disk Read Only Memory
CE	Civil Engineer/Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHEMTREC	Chemical Transportation Emergency Center

CHRIS	Chemical Hazard Response Information System
CMOS	Cargo Movement Operations System
CPC	Chemical Protective Clothing
CWA	Clean Water Act
DECON	Decontamination
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
DOE	Department of Energy
DOT	Department of Transportation
DPO	Disaster Preparedness Operations
DRG	Disaster Response Group
DRMO	Defense Reutilization and Marketing Office
EC	Environmental Coordinator
EIS	Emergency Information System
EM	Environmental Management
EMD	Environmental Management Directorate
EMI	Emergency Management Institute
EPA	Environmental Protection Agency
EPC	Environmental Protection Committee
EPO	Environmental Planning Office
ERG	Emergency Response Group
FCC	Fire Communications Center
FCCO	Fire Communications Center Operator
FEMA	Federal Emergency Management Agency
FES	Fully Encapsulating Suits
FR	Federal Register

FRA	First Responder, Awareness
FRO	First Responser, Operational
GIS	Geographic Information System
HAZMAT	Hazardous Material
HCS	Hazard Communication Standard
HMIMS	Hazardous Materials Incident Management System
HMIS	Hazardous Materials Information System
HMS	Hazardous Materials Specialist
HMT	Hazardous Materials Technician
HMTC	Hazardous Materials Technical Center
HWM	Hazardous Waste Management
IEX	Issue Exemption Code
IRB	Incident Review Board
IRP	Installation Restoration Program
LC ₅₀	lethal concentration
LD ₅₀	lethal dose
LEL	Lower Explosive Limits
LONEX	Local On-Line Network
MAC	Military Airlift Command
MDT	Mobile Digital Terminal
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheets
NCP	National Contingency Plan
NFA	National Fire Academy
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health

NOAA	National Oceanic and Atmospheric Administration
NSN	National Stock Number
OHM-TADS	Oil and Hazardous Materials Technical Assistance Data Systems
OHSPC	Oil and Hazardous Substance Pollution Contingency
ORM	Other Regulated Material
ORNL	Oak Ridge National Laboratory
OSC	On-Scene Coordinator
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PMD	Program Management Directive
PPE	Personal Protective Equipment
RADC	Rome Air Development Center
RCRA	Resource Conservation and Recovery Act
RDCF	Research, Development, Construction, Fire
RTEC	Registry of Toxic Effects of Chemical Substances
RTL	Response Team Leader
RECON	Reconnaissance
SARA	Superfund Amendments and Reauthorization Act
SCBA	Self-Contained Breathing Apparatus
SDWA	Safe Drinking Water Act
SFO	Senior Fire Officer
SHERP	Safety and Health and Emergency Response Plan
SP	Security Police
SPCC	Spill Prevention, Control, and Countermeasures
SPR	Spill Prevention and Response
SRT	Spill Response Team

TLV	Threshold Limit Value
TSCA	Toxic Substances Control Act
TSD	Transportation, Storage, and Disposal
TWA	Time-Weighted Average
USAF	U.S. Air Force
WIMS	Work Information Management System

SECTION I

INTRODUCTION

A. OBJECTIVE

The primary mission of the Environmental Protection for Hazardous Materials (HAZMATs) Incidents project was to assist U.S. Air Force (USAF) fire department personnel in HAZMAT incident management. This objective involved (1) a definition of the extent of HAZMATs, (2) a review of pertinent regulations and job requirements pertaining to HAZMAT incidents, (3) identification and refinement of a computer-assisted incident management system, and (4) a definition of HAZMAT-related issues for fire department personnel, including training and protective clothing. Within the framework of the objective, all major HAZMAT-incident related issues were identified and, to some extent, characterized. Included are proposed solutions to identified problems.

B. BACKGROUND

During the past decade, chemical exposures have become recognized for the potential hazards they actually represent. Before that time, proper caution had not been acknowledged as to inadvertent or even planned exposure regarding hazardous chemicals. With the advent of long-term rodent carcinogen bioassays and, more recently, mutation assays, the list of "hazardous" chemicals has grown from a small handful to hundreds, perhaps thousands. Each year, the list of recognized animal carcinogens and suspected human carcinogens increases.

In recognition of the increasing awareness and better knowledge of potential chemical hazards, the Environmental Protection Agency (EPA), and other governmental agencies have passed a succession of proenvironment regulations to implement laws protecting the individual and the environment. Some of the primary actions have been the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by Superfund Amendments and Reauthorization Act (SARA) of 1986, the Toxic Substances and Control Act (TSCA), the Resource Conservation and Recovery Act (RCRA), Occupational Safety and Health Administration (OSHA) regulations, the Department of Transportation (DOT) regulations, the Safe Drinking Water Act (SDWA), the Clean Water Act (CWA), and the Clean Air Act (CAA). Title III under SARA, in combination with OSHA's Hazard Communication Standard, has become the advocate and warning for the chemical worker and the general public. The Air Force (AF) provided various regulations and standards for interpreting these laws and regulations for the AF community.

Private sector and governmental initiatives are designed to provide remedial action to chemical disposal facilities or contamination sites which environmental hazards exist. Many such locations exist on Air

Force Bases (AFBs) and are being addressed under the Installation Restoration Program (IRP). As with other emergencies, fire protection personnel will be among the first respondents to IRP-related emergencies. This increased awareness requires that first respondents to hazardous chemical incidents must have adequate information about specific hazards involved to cover all phases of hazardous incident response, from preplanning through actual incident response. Many different agencies have been tasked with one or more components of the overall need, often without additional personnel or financial resources. A comprehensive program tailored to meet the fire department's needs did not exist; therefore, this identified need was used to initiate the present program.

C. SCOPE

The scope of this work included the following areas: (1) Determination of the extent of the HAZMAT problem; (2) Characterization and supplementation of overall AF strategy directed toward HAZMAT management, including training and personnel protection needs; and (3) Development of a Hazardous Materials Incident Management System (HMIMS). Within this effort it was also necessary to determine roles and interrelationships of a variety of agencies.

The first task was to determine the extent of the HAZMAT problems relative to incident response at four selected bases, which were selected as reflective of the divergent HAZMAT activities within the AF. Selected were Andrews AFB, Maryland (AF Military Airlift Command); Edwards AFB, California (AF Systems Command); Hanscom AFB, Massachusetts (AF Systems Command); and Tinker AFB, Oklahoma (AF Logistics Command).

HAZMAT problems were reviewed from the perspective of the fire department and of the other incident response agencies. These perspectives are necessary because of the features unique to an AF fire department, particularly the changing role of the fire department with respect to HAZMATs. Other roles for which substantial change was observed related to waste management. In addition to characterizing the extent of the HAZMAT problem, the first task examined resources available for HAZMAT control as well as the HAZMAT response infrastructure.

The second task involved identifying baseline procedures, regulations, and ongoing programs within the AF related to HAZMAT incident management. Included were an understanding of the fundamental philosophies governing decisions and actions; determination of emergency response personnel participation in IRP contract development and in associated safety and health plans; and determination of needs for a HAZMAT inventory and methods for its implementation. In addition, specific training and personnel equipment needs of fire protection personnel were determined and criteria for certification of response personnel were developed.

The third major activity involved identification and development of a prototype software package for HAZMAT incident management. This system was born out of requirements and needs identified in the first two parts of this program.

A comprehensive program to assist the fire department during IRP incidents includes many of the components present during any HAZMAT incident. Therefore, in the interest of efficient use of resources, the present scope entails all normal day-to-day operational requirements as well as all IRP-related hazardous incidents. By including all possible situations in planning for a HIMS, the best interest of the fire department is ensured.

SECTION II

EXTENT OF THE HAZARDOUS MATERIAL (HAZMAT) PROBLEM AT SELECTED AIR FORCE BASES

A. INTRODUCTION

This section provides the AF with an objective evaluation of HAZMAT problems at four selected AF bases that were visited to gain a general understanding of the issues and explore initiatives implemented by AF fire departments and other incident response agencies.

In its broad connotation, the term "hazardous material information," incorporates the identities and locations of any HAZMAT as well as associated procedures and responsibilities. HAZMAT refers to any substance that may pose a risk to health, safety, and property when improperly handled, used, stored, transported, or disposed. These HAZMAT issues have been explored first from a fire department viewpoint and from the perspective of the entire group of HAZMAT response agencies at each base.

In addition to site visits, the project team examined existing AF documents, procedures, and doctrines related to HAZMAT incident response. These collective data form the basis for the information contained in this report.

Despite differences, the extensive information gathering efforts at the four bases applies to all other bases generally.

B. AVAILABILITY OF HAZMAT INFORMATION FOR FIRE DEPARTMENTS

The requirement for increased awareness and involvement in the HAZMAT incidents by fire protection personnel was first revealed by AF/LEE letter of 16 December 1985.* The LEE letter identified the fire department's around-the-clock ability to respond to emergency situations, including HAZMAT. This role is consistent with that defined in Air Force Regulation (AFR) 92-1, paragraph 2-2, in which the main fire protection objective is "to eliminate the causes of fire and reduce loss of life, injuries, and property damage, if fire occurs." However, fires are not always present in a HAZMAT incident. Such situations are addressed in Air Force Occupational Safety and Health (AFOSH) Standard 127-68, Chemical Safety.

*Headquarters AF LEE letter of 16 December 1985.

In addition to AF directives, pressures grew from the ever-increasing legislation. For example, the Hazard Communication Standard of the OSHA Federal Register (Reference 1) requires "all employers to provide information to their employees about the hazardous chemicals to which they are exposed...." In addition, Title III of SARA requires "emergency planning" and "community right-to-know" reporting on hazardous and toxic chemicals.

To comply with requirements, AF fire departments are called upon for a substantially increased commitment. For example, significant and different resources are needed to properly carry out current day responsibilities. Major observations of this study relate to the provision of required resources for the fire departments.

Based on the study of four bases, it is judged that informational resources, particularly information on chemical inventories and computer information systems, are even more of a critical need than physical provisions. Most decisions about the need for additional physical resources (additional manpower, specialized protective suits, HAZMAT cleanup equipment, and material) must be based on a knowledge of potential future incidents; therefore, detailed knowledge about the types of HAZMATs on base and in the surrounding environment is required.

Members of a fire department must expend major efforts to locate, identify, and assess hazard levels of toxic materials so that they can apply this information. Despite major directives related to HAZMAT inventory tracking requirements given to other AF agencies, this situation persists because tasking requirements are imposed without additional resource allocations and centralized authority needed to administer such an effort.

Overall, the availability of HAZMAT inventory information to the fire department is well below the desired level. Their HAZMAT information level is based on inventories developed by fire departments from their own inspections and from some computer or manually processed lists provided to them by other agencies. Some of these lists may be useful, but most need format development and organization into information categories. It must be emphasized that these are fragmented information systems and they do not provide up-to-date, complete, and useful information to a responder.

As the first respondent to HAZMAT incidents, the fire department must have a knowledge of the identities, quantities, and locations of HAZMATs on base, as well as those entering and leaving base. The degree of desired specificity in quantity and location increases with increasing hazard potential of a material. Knowledge about the locations of large quantities of flammable materials as well as very small quantity toxic materials is an absolute necessity. Among the four bases visited, similarities existed in methods used to provide some of the required information; yet, a variety of inventory methods were being used.

The different phases of potential hazard can be broken down into three units: Base Supply, intended use, and waste. In between these aspects of life cycle, elements of storage and transportation are involved. The Base Supply inventory control process is similar from receipt to delivery points at the bases visited. This process begins with the AFOSH Standard 127-68, Chemical Safety, directing that all chemical materials shall be ordered through normal supply channels and that Base Bioenvironmental Engineer (BEE) must be consulted before ordering chemicals that have not been used in a particular shop. Supervisors also are cautioned against borrowing unfamiliar chemicals from other operations without BEE coordination. The BEE is made aware of the growing variety of items in a given shop and cognizant of the volume.

1. Base Supply

Although Base Supply retains knowledge of the delivery point and of the organization purchasing a given material, no uniform system was available to identify "typical inventories" at Base Supply and their storage locations. (At Tinker AFB, an Air Force Logistics Command (AFLC), Form 981, "Stock Record and Locator Form" is used to keep a running stock record for each chemical in hazardous chemical storage. As this is a manual form, it is possible that an exact inventory of that building may be unavailable in an emergency.) Throughout this procurement/supply process, there is no identified fire department involvement; although the BEE is involved in approvals for purchase, and Base Supply receives, stores, and distributes materials.

If a delivery point is to a small building and the chemical is not further transported by the user to another location, there can be relatively good location specificity. Base Supply may have information as to the quantities shipped but not an existing HAZMAT inventory at certain locations. No coupling exists for incoming and outgoing data. At Tinker AFB, Base Supply provides the fire department with monthly Product Distribution Lists DO33 and DO02, containing information on transactions at Tinker AFB for its primary mission as an AFLC (depot) and for transactions for tenants (as Base Supply). The fire department does not consider these lists to be useful, mainly because these lists do not include the proper chemical name of the material or mixture of materials but are listed by National Stock Number (NSN), which is not translated into chemical names and mixtures. There is no specific identification of the receiving location. In addition, tenant units do not always comply with AFOSH 127-68 in terms of having their purchases screened by BEE, and many times follow other practices.

No formal or informal process for systematically obtaining inventory information from Base Supply was identified at Edwards AFB (although an inventory effort had just been started). At Andrews AFB, an inventory list is sent from Base Supply to BEE (every 4 to 6 months). At Hanscom AFB, no central inventory is available; Lincoln Laboratories, one of the tenants, maintains a computerized inventory. Other agencies at Hanscom AFB are required to provide information (usually handwritten) to the fire department. By inputting this information obtained from

users, the fire department at Hanscom AFB hopes to gain some concept of the inventory and of locations of HAZMATs.

2. Transportation

Transportation of chemicals into, out of, and within a base will be discussed in Section IID. Although a variety of agencies may be involved in the normal process, the fire department is involved only when notified of an emergency, and must obtain HAZMAT information when they arrive on scene. The fire department has no prior list to reference.

3. Waste

For three of the bases visited (Andrews, Edwards, and Tinker), once a material becomes waste, it falls under the jurisdiction of the newly formed office of Environmental Management (EM) or Environmental Management Directorate (EMD). This agency is responsible for transportation, storage, removal, cleanup, and disposal of hazardous wastes. The Environmental Coordinator (EC), who works for EM, files necessary reports to inform the state and EPA. In disposal coordination, the EC contacts Defense Reutilization and Marketing Office (DRMO) and inspects the required paperwork.

The EM directs the use of satellite areas and accumulation points for hazardous waste. At Andrews AF base, satellite areas may store hazardous waste under 100 kg per month (in 5-gal containers). If a large amount is to be disposed of at one time, a one-time "generation of waste" form is filed by the EC with the state and a temporary EPA number is granted. Waste is moved regularly from satellite areas to accumulation points. Accumulation points with less than 90 days storage do not require permits. The fire department would have to contact the EC to obtain inventory information on hazardous wastes at the satellite areas or accumulation points. (This information was obtained at Andrews but is relevant to the other bases visited.)

Andrews AFB has approximately 40 accumulation points. From these, the EC regularly moves waste to a permitted storage area, where DRMO takes responsibility for the waste. The fire department is not routinely notified when HAZMATs are transported, unless an accident or incident occurs. However, on a predetermined basis, the fire department performs routine walkthrough inspections. These multipurpose inspections provide the fire department with a general perspective of activities taking place at all locations on base. They provide cross-sectional observations of chemical inventories and locations, including the different stages of waste processing. While specifics of hazardous wastes located at satellite areas, accumulation points, or permitted storage facilities may not be known, information on chemical classes (i.e., solvents, plating waste, acid waste, etc.) and typical quantities are identified.

4. Department of Defense HAZMAT Information System

When a material is identified either by name or NSN, a variety of resources are available to assist the fire department in determining the level of hazard associated with a particular material. The most comprehensive assistance provided by the Department of Defense (DOD) is the Hazardous Materials Information System (HMIS).*

The HMIS, established at the Defense General Supply Center in 1979 is managed by the Defense Logistics Agency. It provides a place to store and access data from a Material Safety Data Sheet (MSDS) acquired during normal DOD procurement processes. The MSDSs are controlled by various focal points; each focal point must analyze its own MSDSs and supply input for the computer files. After the data are reviewed at the Defense General Supply Center, the information is keyed into a computer. The data base includes mostly HAZMATs. Some nonhazardous materials are included to assure that they are not hazardous. The computer records are copied periodically to microfiche and distributed to over 13,000 users.

HMIS on-line was developed by the Hazardous Materials Technical Center (HMTTC) at Rockville, Maryland, to provide easy access to HMIS records. Each record in the HMTTC/HMIS on-line file has more than 60 data fields, some of which may be blank. Four different methods have been established to look at parts of these records. Each output format contains information relevant to a particular group of users: emergency response personnel, industrial hygienists, storage and handling personnel, or transportation specialists. Each output format consists of those data fields used most often by the selected group. Any of the searchable data fields may be used when developing a search.

The HMTTC recently announced the availability of the HMIS on compact-disk read-only memory (CDROM) in addition to microfiche and magnetic tapes. HMIS on CDROM accessed by a personal computer would provide HAZMAT information listed by NSN.

The HMIS is a valuable tool that can be used by the fire departments to assist in hazard determination; yet, a key problem would exist if only NSNs were known and the material was a mixture with a performance standard. Because toxicity/flammability may vary with suppliers, depending on the product components, an NSN is not a unique identifier. In addition, the presence of entries for 30,000 materials does not ensure that the MSDS for each of these entries is complete. A variety of commercially available data bases are available, but they do not usually reference NSN.

*Hazardous Materials Technical Center can be contacted at telephone number (800) 638-8958 for HMIS information.

5. Fire Department HAZMAT Inventory List

Many of the 100,000* recognized research and industrial chemicals are used in support of the AF flying mission. The DOD HMIS contains information on more than 30,000** chemicals; however, there is not an AF specific HAZMAT list.

In the absence of a generic HAZMAT inventory list the Hazardous Materials Issue Report from Eglin AFB was examined (Table 1). The Eglin list had entries for NSNs, nomenclature, and the Issue Exemption Code (IEX), as explained in Section IIE1, AF HAZMAT Classification Systems. The HMIS system was used to identify chemical components for each HAZMAT identified with an NSN. (The same NSN, however was assigned to more than one product. Additional information would be helpful in identifying a specific product.) Identified chemicals were searched in the Computer-Aided Management of Emergency Operations (CAMEO) chemical information file, which is selected for inclusion in the AF computerized HMIS. The CAMEO software is described in Section IIG2.

The Eglin list contained 49 different materials, 33 of which were classified as IEX 9. The DOD HMIS identified 44 of the 49 materials and their components. Paints, thinners, and adhesives made up the bulk of the list; nearly everything is a mixture. A total of 150 components are in the 44 materials and all but 15 (10 percent) of these are found in the CAMEO file. On the basis of this sample, 90 percent of the materials are found in the detailed toxicological MSDS files. Consequently, it is believed that the CAMEO MSDS file, especially prepared for the use of fire departments throughout the United States, is a representative generic HAZMAT MSDS information file for AF use. Inventory entries not found in the CAMEO MSDS file can be entered as needed using the MSDSs of the manufacturer. Under OSHA regulations, all purchases need to be accompanied by an MSDS. For novel chemicals, an MSDS can be prepared by a qualified institution.

Appendix A contains a list of Extremely Hazardous Substances and Toxic Chemicals. Extremely hazardous substances are identified by the EPA. All AF fire departments should be particularly aware of the location and quantity of these materials. Under SARA, Title III, Sections 302 and 304 requirements, if a facility has an extremely hazardous substance greater than the threshold quantity set by the EPA, it is subject to the emergency planning and notification provisions. Identified toxic chemicals must be reported on toxic chemical release forms, if released from a facility (Section 313 of SARA). There are also lists of hazardous chemicals identified by OSHA and under Section 103 (a) of CERCLA.

*Registry of Toxic Effects of Chemical Substances (RTEC), NIOSH database.

**HMIS On-Line User's Guide Reference Manual, August 29, 1986.

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE

NSN	Nomenclature	U/I	IEX	Hazardous Components (%) (HMIS)	CAMEO Disk File
8010005843148	Lacquer orange	PT	9	Toluene 19.0 Acetone 45.0 Butyl acetate 6.0 Butyl cellosolve 2.0 Isobutane 14.0	
8010005843150	Lacquer spray, white	PT	9	Toluene 19.0 Acetone 45.0 Butyl acetate 6.0 Butyl cellosolve 2.0 Isobutane 14.0	007-4654 001-8 002-2672 031-3412 036-8744
8010000793762	Enamel white	PT	9	Aliphatic naphtha 47.0 Xylene substitute 43.0 Aliphatic hydro- carbons 6.0 N-butyl-alcohol <5.0	005-8871 N/A 004-851 002-277
8010001818079	Thinner coating	CN	9	Methyl ethyl ketone 30.0 Ethylene glycol ethyl ether acetate; ethyl cellosolve acetate 40.0 N-butyl acetate 10.0 Xylene 8.0 Toluene 12.0	005-1105 N/A 002-2672 007-8151 007-XX54
8010010172480	Polyurethane	KT	9	Not available	
8010010234260	Polyurethane	KT	9	Methyl ethyl ketone Ethylene glycol ethyl ether acetate; ethyl cellosolve acetate 22.0 Ethyl acetate 12.0 Lead chromate pigment 2.0 Non-aqueous solu- tion, hazard un- known, unidenti- fied	N/A 030-665 N/A
6810001844796	Acetone	CN	8	Acetone 100.0	

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONTINUED)

NSN	Nomenclature	U/I	IEX	Hazardous Components (%) (HMIS)		CAMEO Disk File
5810011200408	Methyl ethyl ketone	LB	9	Methyl ethyl ketone peroxide (in dimethyl phthalate)	49.0	042-7064
				Oxygen (as active oxygen)	8.9	N/A
8010005825382	Lacquer black	PT	9	Methylene chloride	40.0	024-3154
				Toluene	12.2	007-4654
				Butyl-cellosolve	3.1	031-3412
8040001178510	Adhesive	TU	8	Not available		
8010010234261	Polyurethane	KT	9	Methyl ethyl ketone	42.0	005-1105
				Toluene	9.0	007-4654
				Ethylene glycol monoethyl ether acetate; ethyl cellosolve acetate	14.0	031-3414
				1, 6-Hexamethylene diisocyanate; hexamethylene diisocyanate monomer	0.15 5.0	035-3579 007-8151
8040001182695	Adhesive	TU	8	Xylene		
				Methyl ethyl ketone	5	005-1105
				Silane	UNK	053-4434
6810002865435	Isopropyl alcohol	GL	8	Isopropanol	100	005-946
8010001412952	Lacquer red	PT	9	Toluene	59.0	007-4654
				Xylene	7.0	007-8151
				Ethylene glycol monobutyl ether (butyl cellosolve)	<3.5	031-3412
				Methyl ethyl ketone	<3.5	005-1105
8010001605787	Thinner lacquer	GL	9	Isobutyl acetate	15	036-3662
				Lactol spirits (50% distillation tem- perature 206°F)	30	N/A

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONTINUED)

NSN	Nomenclature	U/I	IEX	Hazardous Components (%) (HMIS)		CAMEO Disk File
8010001605789	Thinner	DR	9	Toluol (50% distil- lation temperature 231°F)	18	007-4654
				Isopropyl alcohol	15	004-496
				Methyl ethyl ketone	22	005-1105
				Isobutyl acetate	15	036-3662
				Lactol spirits (50% distillation tem- perature 206°F)	30	N/A
				Toluol (50% distil- lation temperature 231°F)	18	007-4654
8010001818080	Thinner, polyurethane	GL	9	Isopropyl alcohol	15	004-496
				Methyl ethyl ketone	22	005-1105
				Methyl ethyl ketone	30.0	005-1105
				Ethylene glycol ethyl ether acetate; ethyl cellosolve acetate	40.0	N/A
				N-butyl acetate	10.0	002-2672
				Xylene	8.0	007-815.1
8010001818281	Coating white	KT	9	Toluene	12.0	007-4654
				Methyl ethyl ketone	40.0	005-1105
				Xylene	5.0	007-8151
				Ethylene glycol monoethyl ether acetate; ethyl cellosolve acetate	20.0	031-3414
				Hexamethylene diisocyanate monomer;		
				1, 6 hexamethylene diisocyanate	0.2	035-3579
				Biuret of hexamethylene diisocyanate	34.8	N/A

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONTINUED)

NSN	Nomenclature	U/I	EX	Hazardous Components (%) (HMIS)		CAMEO Disk File
8010002906984	Lacquer, acrylic black	PT	9	Methylene chloride	33.0	024-3154
				VM&P naphtha	16	005-8871
				Isobutane- propane (50.50 mol wt%)		036-8744 006-9018
				Toluol	2.0	007-4654
				Butyl cellosolve	1.5	031-3412
8010006169181	Primer gray	PT	9	VMP naphtha	4.6	
				Toluol	31.3	007-4654
				Methyl isobutyl ketone	2.2	005-3943
				Propane	14.6	006-9018
				Isobutane	14.6	036-8744
8010008529033	Enamel yellow	PT	9	Mineral spirits	14.8	005-8871
				Methylene chloride	30.7	024-3154
				VM&P naphtha	4.2	005-8871
6830009022430	Propel instant	CN	8	Dichlorodifluoro- methane	100	003-3138
6830001061659	Freon 22	CY	8	Chlorodifluoro- methane	100	018-2889
6810002388119	Naphtha	GL	8	Light aliphatic solvent naphtha	99.0	005-8871
6810002812762	Methyl ethyl ketone	CN	9	Methyl ethyl ketone	100	005-1105
6810002812785	Methyl ethyl ketone	GL	9	Methyl ethyl ketone	99.0	005-1105
8010000822450	Primer	KT	9	Methyl ethyl ketone	15.0	005-1105
				N-butyl acetate	15.0	002-2672
				Strontium chromate	15.0	055-4547
				Lead chromate	5.0	N/A
				Toluene	10.0	007-4654

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONTINUED)

NSN	Nomenclature	U/I	IEX	Hazardous Components (Z) (HMIS)		CAMEO Disk File
8010001818277	Polyurethane	KT	9	Methyl ethyl ketone	40.0	005-1105
				Toluene	5.0	007-4654
				Ethylene glycol mono ethyl ether acetate; ethyl cellosolve acetate	20.0	031-3414
				Hexamethylene diisocyanate monomer; 1,6. hexamethylene diisocyanate	0.2	035-3579
				Biuret of 1,6. hexamethylene diisocyanate	34.8	N/A
				Methyl ethyl ketone	13.1	005-1105
8010001818300	Polyurethane	KT	9	Ethylene glycol ethyl ether acetate; ethyl cellosolve acetate	15.1	N/A
				Ethyl acetate	11.1	030-665
				Lead chromate yellow	17.6	N/A
				Polyester resin	29.2	N/A
				Toluene	9.0	007-4654
				Acetone	45.0	001-8
8010005843154	Lacquer spray	PT	9	Butyl acetate	6.0	002-2672
				Butyl cellosolve	2.0	031-3412
				Isobutane	14.0	036-8744
				Toluene	18.6	007-4654
				Methylene chloride	33.3	024-3154
				Propellant (propane-isobutane 50:50 mol wt Z)	30.7	006-9018 036.8744
8010007219744	Lacquer, yellow	PT	9	Lead	2.8	N/A

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONTINUED)

NSN	Nomenclature	U/I	IEX	Hazardous Components (Z) (HMIS)		CAMEO Disk File
8010011046537	Polyurethane	KT	9	Not available		
8010011072187	Polyurethane	KT	9	Not available		
8030008238039	Powder concentrate	GL	9	Chromic acid	<5	003-2940
				Sodium silico- fluoride	<0.5	055-9083
6605008095252	Compass magnet	EA	9	Not available		
6840004592443	Wasp-Freeze®	CN	8	Methylene chloride	11.0	024-3154
				Perchloroethylene	32.0	007-4591
				Trichloromono- fluoromethane	20.0	058-9134
				Dichlorodifluoro- methane	20.0	003-3138
				Petroleum distillate	13.8	005-8871
6810002232739	Acetone, technical	PT	8	Acetone	100	001.8
6810002010907	Alcohol, denatured	CN	8	Ethyl alcohol	94.9	004-667
				Methyl alcohol	5.1	005-3874
6810002056786	Alcohol denatured	QT	8	Ethanol	90	004-667
				Methanol	4	005-3874
				Isopropanol	6	004-946
6840010676674	Insecticide	CN	8	D-phenothrin	2	N/A
				Dichlorofluoro- methane	49	024-3151
				Trichlorodifluoro- methane	49	N/A
8010001605794	Thinner, synthetic	GL	8	Petroleum dist.	> 9	005-8871
				N-butanol	> 9	002-277
				Toluene	> 9	007-4654
				Isobutyl isobutyrate	> 9	036-3669
8010006632673	Sealar wood	GL	8	Naphtha aliphatic	25	005-8871
				Toluene	15	007-4654
				Isobutyl acetate	15	036-3662
				Isopropyl alcohol	8	004-946
				Isobutyl alcohol	8	036-3661

TABLE 1. HAZARDOUS MATERIALS ISSUE REPORT, EGLIN AIR FORCE BASE
(CONCLUDED)

NSN	Nomenclature	U/I	IEX	Hazardous Components (%) (HMIS)		CAMEO Disk File
8010008998825	Primer	PT	9	Toluene	44	007-4654
				Isopropyl alcohol	5	004-946
				Methyl isobutyl ketone	10	005-3943
				Ethylene glycol monobutyl ether	1	031-3412
				Acetone	40	001-8.
8040009646756	Adhesive	KT	8	Not available		
8010009003648	Paint, Traffic, yellow	CN	8	Pigments (50.53% of product)		N/A
				Vinyl toluene butadiene (as vehicle) (47.50% of product)		N/A
				Solvents (type not specified) (33.34% of product)		N/A
				Additives (0.5.1% of product)		N/A
6810002423645	Ethyl alcohol	GL	8	Ethyl alcohol	92.4	004-667
				Water	7.6	N/A
8010005843149	Lacquer, olive drab	PT	9	Toluene	19.0	007-4654
				Acetone	45.0	001-8
				Butyl acetate	6.0	002-2672
				Butyl cellosolve	2.0	031-3412
				Isobutane	14.0	036-8744
8010008998825	Primer	PT	9	Toluene	44	077-4654
				Isopropyl alcohol	5	004-946
				Methyl isobutyl ketone	10	005-3943
				Ethylene glycol, monobutyl ether	1	031-3412
				Acetone	40	001-8
6810002372955	Hydrochloric acid	BT	9	Hydrochloric acid	37.5	004-5020
				Unidentified com- ponent (as impur- ities) not speci- fied by mfr.	UNK	N/A

6. HAZMAT Inventory List for Aerospace Vehicles

Aerospace vehicles are defined in AFR 92-1 (C2) as piloted and pilotless aircraft, gliders, drones, helicopters, rockets, missiles, or a combination of these vehicles. A short list of HAZMATs in present use in the AF aerospace missions follows:

Aircraft	Rockets and missiles
Gasoline	Liquid hydrogen
JP-4	Liquid oxygen
JP-5	Monoethylhydrazine
JP-7	1,1-Dimethylhydrazine
JP-8	Dinitrotetraoxide
JP-9	Ammonium perchlorate
JP-10	Aluminized synthetic-rubber binder
RJ-5	
Methylchlorohexane	
Hydraulic fluids	
Lube oils	
Greases	
Hydrazine	

According to information obtained from the Market Research Department at the Defense Fuel Supply Center at Washington, D.C., over 99 percent of AF fuels for aerospace vehicles are JP-4, JP-5, and JP-8. The most commonly used fuel is JP-4, which is naphtha-based and similar to Jet-B that is infrequently used commercially. The next most commonly used fuel is JP-5 which is kerosene-based and is similar to European Jet A-1. However, JP-5, has a higher flashpoint. Presently JP-8 is the least-used fuel but its usage is increasing. This is also a kerosene-based fuel similar to the commercial European Jet A-1. The rest of the AF fuels are aviation gasoline, including some experimental fuels.

7. Base Specific HAZMAT Information Systems

The level of information on HAZMATs available to the fire departments visited is less than desirable and may remain so for at least the next several years. The overall HAZMATs tracking situation will be improved within the Logistics Command, because AFLC Regulation 161-1 will require that a master base inventory be centrally maintained and continuously updated. Current copies of the master inventory are to be distributed quarterly at Tinker AFB to emergency response activities

(like the fire department). The master inventory will identify NSN, manufacturer's and trade name, unit of issue, quantity on hand (and consumption rate), physical location, organization, supervisor, and RCRA waste contribution (quantity and EPA Identification Number). Another concept, PHOENIX, being developed at Hill AFB enhances the scope of the inventory mandate. The PHOENIX concept will integrate information on occupational medicine, bioenvironmental attributes, and environmental health in conjunction with the inventory information. This merger will allow future health trend analyses to be performed.

Plans are under way at Edwards AFB to develop a base-wide computerized chemical inventory and tracking system that will track materials from entry into the Base Supply function through their disposal as wastes. Initially, data will be downloaded from the Base Supply computer system or other computer databases maintained by tenants. Tenants and contractors who do not operate through Base Supply will have to provide information manually. Implementation of this planned tracking program depends on compliance by all parties. The enforcement process is driven through the Environmental Protection Committee (EPC), which consists of the deputy chief of each tenant unit and of each major agency on base such as BEE and the fire department. As Chairman of the EPC the Base Vice Commander ensures compliance. Plans are to tie future host agreements with tenants at Edwards AFB to compliance. Hence, a more or less complete tracking system will be implemented.

A similar process is under way at Hanscom AFB. A Hazardous Materials Committee was formed in February 1986; this is the planning body for handling HAZMATs. The committee was made a subcommittee of the Base Commander's Safety and Health Council in August 1986. All potential agencies involved (users), plus HAZMAT emergency responders, are a part of this subcommittee, and participation by all chemical users enhances the possibility of a full inventory. Each tenant is to provide the fire department with a room-by-room inventory. (Lincoln Laboratories can provide an on-line inventory.) Some difficulties still exist with local purchases; however, once recognized, these can be addressed.

Hanscom AFB operates under a slightly different philosophy than most AF bases because most of its tenants are research-type laboratories rather than production facilities. Consequently, it must be the responsibility for the person in charge of a given laboratory to be able to respond to an emergency. This philosophy has worked well in several emergency situations when leaks of toxic gases were suspected.

Due in large measure to the successful implementation of the Hazardous Materials Committee, Hanscom AFB has the potential to provide HAZMAT information in the form desired by the fire department. If there are no AF system command mandates to provide information suitable to the fire department, the next best thing is to have a Materials Subcommittee. The fire department can then identify its needs to the subcommittee. Once certified by the Base Commander, specific actions can then be taken.

During the course of our investigation, HAZMAT management had not been consistent. For example, between the spring and fall of 1987, the EC position was established at Andrews AFB. Another base visited, Edwards AFB, had such an office which also monitored IRP activities. After that visit, the IRP effort moved outside the EC's domain. The observed dynamics related to HAZMATs management were viewed as positive because newer initiatives or directions are seen as providing a more localized and comprehensive framework from which the fire department may gain information.

Often needs regarding knowledge of inventory overlap (e.g., BEE may have a requirement to record work history along with personnel information, as in the PHOENIX concept). All AFBs should have comprehensive inventory tracking plans that can meet the needs of a variety of users such as BEE, Base Supply, the fire department, the EC, and DRMO. Implementation of such a plan would seem to require the full-time attention of personnel specifically dedicated to that task. The general tendency at present is that a variety of tasks related to HAZMATs management are assigned as "additional duty" to already overloaded personnel.

C. HAZMATs IDENTIFIED DURING INSTALLATION RESTORATION PROGRAM ACTIVITIES

1. Chemical Inventory

The Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5 defines a comprehensive program to identify and evaluate past DOD HAZMAT disposal sites on DOD installations and to control migration of hazardous environmental contaminants resulting from such sites into ground water. The AF IRP received initial guidance in January 1982.

There are four phases to the IRP:

Phase I - contaminant problem identification,
Phase II - verification/quantification by sampling and analysis,
Phase III - technology development,
Phase IV - remedial action.

Primarily actions taken during Phases III and IV are of most concern to first respondents to HAZMAT incidents. Discussions with IRP personnel at the four AF bases surveyed suggested that the prevalent contaminants were fuels and solvents. An AF IRP Toxicology Guide was developed to assist personnel who are responsible for the management of hazardous waste. Chemicals included in the guide (Table 2) were chosen after a review by the AF Occupational and Environmental Health Laboratory of all IRP Phase II reports available in March 1984. Thus, these chemicals generally are considered by the AF to be chemicals or mixtures most likely to be encountered at any AF base during the latter two

TABLE 2. AIR FORCE INSTALLATION RESTORATION PROGRAM TOXICOLOGY GUIDE.

Chemical name	CAS number ^a	NIOSH number ^b
Acetone	67-64-1	AL3150000
Aroclor-1016	12674-11-2	TQ1351000
1242	53469-21-9	TQ1356000
1254	11097-69-1	TQ1360000
1260	11096-82-5	TQ1362000
Benzene	71-43-2	CY1400000
Bis(2-chloroethyl) ether	111-44-4	KN0875000
Bromochloromethane	74-97-5	PA250000
Butyl benzyl phthalate	85-68-7	TH9990000
Carbon tetrachloride	56-23-5	FC4900000
Chlordane	57-74-9	PB9800000
Chlorobenzene	108-90-7	CZ0175000
Chloroethane	75-00-3	KH7525000
Chloroform	67-66-3	FS9100000
o-Chlorophenol	95-57-8	SK2625000
Cyanide-CN	57-12-5	GS7175000
HCN	74-90-8	MW6825000
NaCN	143-33-9	VZ7525000
KCN	151-50-8	TS8760000
2,4-D	94-75-7	AG6825000
DDD	72-54-8	KI0700000
DDE	72-55-9	KV9450000
DDT	50-29-3	KJ1325000
Diazinon	333-41-5	TF3325000
Dibromochloromethane	124-48-1	PA6360000
Dibromomethane	74-95-3	PA7350000
1,2-Dichlorobenzene	95-50-1	CZ4500000
1,3-Dichlorobenzene	541-73-1	CZ4499000
1,4-Dichlorobenzene	106-46-7	CZ4550000
1,1-Dichloroethane	75-34-3	KI0175000
1,2-Dichloroethane	107-06-2	KI0525000
1,1-Dichloroethylene	75-35-4	KV9275000
1,2-Dichloroethylene		
cis-1,2-dichloroethylene	156-59-2	KVS420000
trans-1,2-dichloroethylene	156-60-5	KV9400000
mixed-1,2-dichloroethylene	540-59-0	KV9360000
2,6-Dichlorophenol	87-65-0	SK8750000
1,2-Dichloropropane	78-87-5	TX9625000
Diethyl phthalate	84-66-2	TI1050000
Di(2-ethylhexyl)phthalate	117-81-7	TI1925000
2,4-Dimethylphenol	105-67-9	ZE5600000
Di-n-butyl phthalate	84-74-2	TI1035000
2,6-Dinitrotoluene	606-20-2	XT1925000
Ethyl benzene	100-41-4	DA0700000
Ethylene dibromide	106-93-4	KH9275000
Ethylene glycol	107-21-1	KW2975000

TABLE 2. AIR FORCE INSTALLATION RESTORATION PROGRAM TOXICOLOGY GUIDE
(CONCLUDED).

Chemical name	CAS number	NIOSH number
Fuel oil (unspecified)	-	LS8950000
Kerosene	8008-20-6	OA5500000
Fuel oil no. 2	68476-30-2	HZ1800000
Fuel oil no. 4	68476-31-3	-
Fuel oil no. 6	68553-00-4	-
Gasoline (automotive)	8006-61-9	LX3300000
Hydraulic fluid	-	-
Hydrazine	302-01-2	MU7175000
JP-4 (jet fuel 4)	-	-
Lindane	58-89-9	GV4900000
Malathion	121-75-5	WM8400000
Methyl cellosolve	109-86-4	KL5775000
Methylethylketone	78-93-3	EL6475000
Methylene chloride	75-09-2	PA8050000
Naphthalene	91-20-3	QJ0525000
N-nitrosodimethylamine	62-75-9	IQ0525000
N-nitrosodiphenylamine	86-30-6	JJ9800000
Oil (mineral base crankcase)	-	-
Oil (synthetic crankcase)	-	-
Pentachlorophenol	87-86-5	SM6300000
Phenol	108-95-2	SJ3325000
Sodium chromate	7775-11-3	GB2955000
Stoddard solvent	8052-41-3	WJ8925000
2,4,5-T	93-76-5	AJ8400000
2,4,5-TP	93-72-1	UF8225000
2,3,7,8-Tetrachlorodibenzo- p-dioxin	1746-01-6	HP3500000
1,1,2,2-Tetrachloroethane	79-34-5	KI8575000
Tetrachloroethylene	127-18-4	KX3850000
Tetraethyl lead	78-00-2	TP4550000
1,2,4-Trichlorobenzene	120-82-1	DC2100000
1,1,1-Trichloroethane	71-55-6	KJ2975000
Trichloroethylene	79-01-6	KX4550000
Trichlorofluoromethane	75-69-4	PB6125000
Tri-o-cresyl phosphate	78-30-8	TD0350000
Toluene	108-88-3	XS5250000
Vinyl chloride	75-01-4	KU9625000
Xylene		
mixed-xylene	1330-20-7	ZE2100000
m-xylene		ZE2190000
o-xylene	108-38-3	ZE2275000
p-xylene	95-47-6	ZE2450000
	106-42-3	ZE2625000

^aNumeric designation assigned by the American Chemical Society's Chemical Abstract Service which uniquely identifies a chemical compound.

^bNational Institute of Occupational Safety and Health identifier number.

phases of the IRP. Phase II reports, which contain information on chemicals actually determined to be present at a specific site, can be obtained by the fire department from the responsible base IRP agent. Specific health and safety plans related to IRP actions may be obtained from the same source.

2. Interaction of Fire Departments with the Installation Restoration Program

Active digging, handling, and transportation of IRP materials only comes during the latter stages of the IRP process, so involvement of the fire department until then is minimal. The present trend is that AF bases contract Phase III and Phase IV work to private companies.

Usually the fire department receives an initial formal notification from the Base Commander of IRP activities indicating a need for fire department support to the outside contractor when he comes on base. Because of the potential liability involved, most contractors plan carefully to preclude emergency calls to the fire department.

Each hazardous waste site scheduled for remediation requires a separate Health and Safety Plan specifying levels of anticipated personnel protection. (The bases visited gave no indication that the fire department is involved in the preparation of these health and safety plans, nor was routine interaction planned with the fire department other than in an emergency.) However, if there was an anticipated hazard, such as digging near a gas line, a fuel tank, or buried explosives, the fire department would be briefed before beginning the work, and, under extreme circumstances, might be asked to be present during the operation. During the course of our investigation, no such situation was identified.

D. AVAILABILITY AND SOURCES OF HAZMAT INFORMATION FOR HAZMAT TRANSPORTED WITH AIR FORCE AND CONTRACTOR-OPERATED MOTOR, RAILROAD, AND AEROSPACE VEHICLES

Guidance on the transport of HAZMATs is provided in AFOSH 127-68, Chemical Safety. All commercial carriers transporting hazardous chemicals are required to comply with the DOT regulations set forth in Title 49 of the Code of Federal Regulations (CFR) requirements.* Hazardous chemicals transportation on AF aircraft must comply with AFR 71-4, Preparation of Hazardous Materials for Military Air Shipment. Transportation of chemicals on base in government or contractor-owned vehicles shall be accomplished with vehicles in good condition, appropriate

*Different volumes of CFR can be purchased from Government Printing Office, Washington, D.C.

tie-downs to prevent tipping and breakage, and an approved fire extinguisher. Appropriate HAZMAT placards shall be used on each vehicle. Transport of hazardous chemicals on base in privately owned vehicles is strictly prohibited.

A list of hazardous chemicals that could be transported into or within a given AF base would contain all materials maintained by Base Supply, materials approved for purchase by BEE, and those materials purchased by tenants. This latter group may or may not have been approved by the BEE. It seems impractical at present to attempt to monitor individual shipments or even to be aware of them. An exception to this position would be the transport of an especially dangerous material in sufficient quantity to warrant an alert status.

The AF Fire Protection Program as outlined in AFR 92-1 provides guidance regarding all aspects of fire protection. It directs that notification be made to the fire department of HAZMAT movement on base (according to AFR 127-100) and of any aircraft carrying dangerous materials (AFR 55-14).

According to the DOT regulations, HAZMATs traveling on public carriers must be properly classed, described, packaged, marked, labeled, and ready for shipping before any person may offer or accept the HAZMATs for transportation (49 CFR 171-178). Labeling requirements are found in 49 CFR 172. DOT labels are illustrated in Figure 1. Hazardous materials vehicles must be placarded on each end and side with the specified placards detailed in 49 CFR 172.519 through 172.558. DOT placards are illustrated in Figure 2. The following discussion can be broken into three major components: motor vehicles, railroad vehicles, and aerospace vehicles.

1. Motor Vehicles

Transportation of HAZMATs on public highways is regulated by the DOT (49 CFR 390-397 covering Federal Motor Carrier Safety Regulations). These regulations apply when there is any involvement with the private sector and include motor vehicles. [If the motor vehicle is completely owned by the AF and operated by AF personnel, in principle, the vehicle is not subject to DOT regulations. However, guidance provided in joint service regulations (AF 75-1 and 75-2) directs the normal procedures to be in compliance with DOT regulations.] Main exceptions may be in the event of security classified shipments, although general placarding will be used regarding chemical hazard class of the item with the greatest hazard.

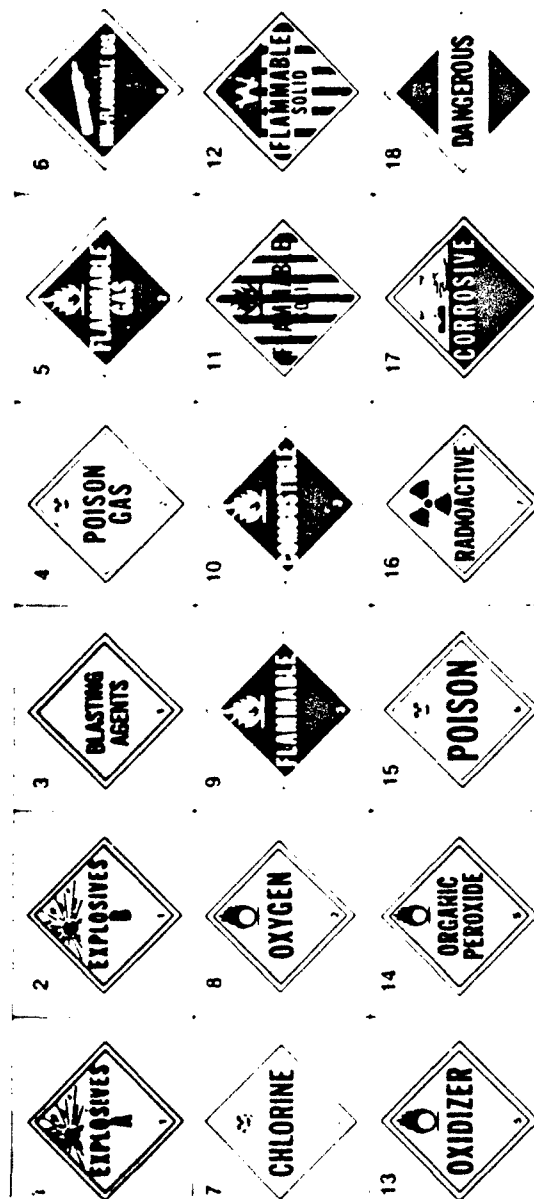
DOT regulations are very specific about the kinds of information required before a shipment can be made. HAZMATs cannot be transported unless the vehicle is properly marked and placarded, except in an emergency (as stated in 49 CFR 177.823). Identification involves placarding on the external surfaces of the vehicle as well as the preparation and carrying of shipping papers. The shipping papers described in 49 CFR 172c contain detailed information and are prepared to provide

Hazardous Materials Warning Labels

DOMESTIC LABELING									

Figure 1. DOT Hazardous Materials Warning Labels.

DOT Hazardous Materials Warning Placards



• Numbers in each square (illustration numbers) refer to TABLES 1 and 2.

Figure 2. DOT Hazardous Materials Warning Placards.

information consistent with guidelines in the DOT Emergency Response Guide (ERG) (Reference 2). Shipping papers should contain the shipping name, classification, and identification number of the HAZMAT and should be accessible. As described in 49 CFR 177.817, the normal location would be within the driver's reach when restrained by a lap belt. However, a first responder should be able to retrieve the shipping papers if an incident occurs that precludes the driver from helping to locate the papers.

Details on the shipping papers provide cargo identification information of generic nature (i.e., flammable, caustic, etc.) or, when necessary, very detailed information (i.e., methylethylketone, hydrogen cyanide). Generally the more commonly transported chemicals (e.g., sulfuric acid) or those possessing special hazards (e.g., nitrogen tetroxide) will be designated by chemical or trade name. HAZMATs are also identified by unique United Nations or North American numbers, which correspond to a detailed list of emergency actions provided in the DOT ERG. The DOT ERG was developed as a guide for initial actions needed to help emergency services personnel protect themselves and the public from incidents involving HAZMATs. Identification of special HAZMATs by the first responder is a major goal in the design of the shipping papers. If the first responder needs additional information, there are resources available, such as the Chemical Transportation Emergency Center (CHEMTREC),* the Oil and Hazardous Materials Technical Assistance Data Systems (OHM-TADS),** and other on-line chemical identification and response services. Information can be obtained through these services to stabilize the incident.

If the shipping papers are destroyed or are otherwise inaccessible, some level of information is available on the vehicle's external surface in the form of placards and on packages and drums in the form of chemical hazard labels. Motor carriers must be provided with required placards for the HAZMATs being transported, and the placards must be affixed as indicated in 49 CFR 172.506. While only generic information is usually presented, at least some indication is given as to the immediate precautionary steps to be taken while additional information is being gathered.

Shipments by common carrier into an AF base, leaving an AF base, or having any private sector involvement will automatically be in compliance with DOT and with state and local laws (49 CFR 390.30, 397.3), since they would have been under or would come under DOT jurisdiction en route. Thus, all common carriers requiring assistance by fire

*CHEMTREC telephone number is (800) 424-9300.

**OHM-TADS can be accessed from terminals at the 10 EPA Regional Offices, from EPA Headquarters in Washington, D.C., and from Coast Guard Marine Safety Office.

protection personnel should, in principle, be accompanied by sufficient information to assist first responders in identifying the materials in transport.

Shipments within boundaries of the base do not fall under DOT jurisdiction. Base Supply is in control of transporting materials from Base Supply to the user. Detailed supply procedures are contained in AFR 67-1. A local issue document provides information for the AF delivery personnel, but has little value for first responders. In some instances, motor vehicles will proceed with their incoming load directly to the user without being unloaded at Base Supply. These vehicles will be placarded and will contain detailed shipping papers. If materials are transported from the supply function to a user organization, there is information sufficient to document transfer of goods (Form DD 1348-1, Figure 3) but not in such form and detail that could maximize the effectiveness of a first responder. Form DD 1348-1 is a DOD single-item release document. Some of this information can be of assistance to the HAZMAT incident responder. The most important parts of the form are U and X. Part U is the freight classification nomenclature, providing for general hazard classification, and Part X is the item nomenclature that specifically identifies the material. The document also contains the issue exception code, which is a rough health hazard indicator. The item stock number recorded may help to determine the chemical or mixture of chemicals in the package.

2. Railroad Vehicles

Although jurisdiction over railroad vehicles is similar to that of motor vehicles, slight differences occur, primarily related to the mode of operation. Again, DOT regulations are carefully spelled out in 49 CFR 174. Rail cars carrying the HAZMAT must have the appropriate placard displayed on the vehicles, containers, or portable tanks (49 CFR 172.508). HAZMATs cannot be transported in rail cars unless the cars are marked and placarded as required (49 CFR 174.59).

A reserve supply of labels and placards must be maintained by the rail carrier so that any lost or destroyed labels or placards can be replaced (49 CFR 174.33). A numbered notice showing the location of each placarded car must be delivered to the train and engine crew involved (49 CFR 174.26a) and must be kept by each depot where a change of rail cars was made.

The shipping papers for any HAZMAT must contain the notation "placarded" followed by the selected placard. Class DOT-113 tank cars that contain a flammable gas must have a notation such as "DOT-113A" and the statement, "Do not hump or cut off car while in motion" (49 CFR 177.203g). Shipping papers must be received before HAZMATs can be transported (49 CFR 174.24), and a member of the train crew must have them in his possession (49 CFR 174.26c). Consequently, during a HAZMAT incident, identifying placards and examining shipping papers (when obtainable) are the main sources of information for AF fire department personnel.

3. Aerospace Vehicles

Civilian air transport of HAZMATs is regulated by DOT in 49 CFR 175. The Military Airlift Command (MAC) has issued joint service publication AFR 71-4, Preparation of Hazardous Materials for Military Air Shipment, which has essentially the same requirements in labeling, marking, and preparation of shipping papers as the DOT regulations. The Transportation Management Office assures compliance with AF documentation. The requirement in 49 CFR 172c prohibits the transportation of a HAZMAT by passenger-carrying aircraft. "Cargo aircraft only" must appear after the basic description on the shipping papers (49 CFR 177.203f), and the Flight Captain must have a copy of the shipping papers (49 CFR 175.35).

For air transport, the Base Transportation Office may know the contents of incoming flights by means of preshipping labels. This provides only general hazard information. If special hazards are present, more specific information may be available. For outbound flights, the Base Transportation Office will have much more detailed information. The fire protection community does not routinely receive HAZMAT information on transported chemicals or have automatic access to this information. During an incident, the fire department must obtain the available HAZMAT information from the Base Transportation Office.

4. Hazardous Waste and Transport

The RCRA of 1976, as amended, regulates management of hazardous waste including the generation, transportation, treatment, storage, and disposal of such waste. On 21 October 1980, DOD issued its overall policy guidance for implementing RCRA regulations. DOD designated each installation commander as responsible for ensuring that all operations, including those of tenants, comply with RCRA requirements. The Defense Logistics Agency, through its Defense Reutilization and Marketing Service, was assigned responsibility for providing hazardous waste storage and disposal services to installation commanders. Transportation from the user to satellite or accumulation points, operated by the DRMO while on base, is accompanied by Form DD 1348-1 (Figure 3), discussed earlier in this section.

When transporting hazardous waste from DRMO by a disposal contractor to a disposal facility as detailed in 49 CFR 172.205, all regulations in 49 CFR that pertain to mode of transportation must be followed (exceptions only, as stated). Regulations implementing RCRA require that the transfer of hazardous waste to a disposal facility be documented, using EPA manifest system. The manifest document (Figure 4) is the EPA-required form used for recording the shipment of hazardous wastes from the generator to the disposal site. Hazardous waste generators through DRMO are responsible for preparing the manifests and confirming that the waste is delivered to the designated disposal site. A copy of the manifest accompanies the shipment and is received by the disposal site to record wastes received. The signed copy of the manifest is returned to the generator, DRMO, to confirm that the wastes

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80		DOCK IDENT FROM 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80		SHIP TO		MARK FOR PROJECT		TOTAL PRICE DOLLARS TC'S	
A WAREHOUSE LOCATION		B UNIT WEIGHT LBS		C FREIGHT RATE		D DOCUMENT DATE		E QUANTITY	
F SUBSTITUTION DATA ITEM ORIGINALLY REQUESTED		G UNIT CARGO PALK		H UNIT WEIGHT LBS		I UNIT WEIGHT LBS		J UNIT WEIGHT LBS	
K ITEM NOMENCLATURE		L UNIT WEIGHT LBS		M UNIT WEIGHT LBS		N UNIT WEIGHT LBS		O UNIT WEIGHT LBS	
P SELECTED BY AND DATE		Q TYPE OF CONTAINERS		R TOTAL WEIGHT		S RECEIVED BY AND DATE		T INSPECTED BY AND DATE	
U PACKED BY AND DATE		V NO OF CONTAINERS		W TOTAL CUBE		X WAREHOUSE BY AND DATE		Y WAREHOUSE LOCATION	
Z REMARKS		AA FIRST DESTINATION ADDRESS		AB DATE SHIPPED		AC RECEIVER'S SIGNATURE (AND DATE)		AD RECEIVER'S DOCUMENT NUMBER	
13 TRANSPORTATION CHARGEABLE TO		14 B LADING A-B SUPPLIER'S SIGNATURE (AND DATE)		15 RECEIVED DOCUMENT NUMBER		16 RECEIVED DOCUMENT NUMBER		17 RECEIVED DOCUMENT NUMBER	

DD FORM 1348-1 1 MAR 74 (4 PART)

Figure 3. Form DD-1348-1, a DOD Single Item Release Document.

Please print or type. (Form designed for use on letter 12 pitch typewriter)

Form Approved OMB No. 2070-1014 Expires 7-1-81

UNIFORM HAZARDOUS WASTE MANIFEST		21 Generator's US EPA ID No.		Manifest Document No.		2 Page 1 of 1 Information in the shaded area is not required by Federal law.	
3 Generator's Name and Mailing Address						A State Manifest Document Number	
4 Generator's Phone ()						B State Generator's ID	
5 Transporter 1 Company Name				6 US EPA ID Number	C State Transporter's ID		
7 Transporter 2 Company Name				8 US EPA ID Number	D Transporter's Phone		
9 Designated Facility Name and Site Address				10 US EPA ID Number	E State Transporter's ID		
					F Transporter's Phone		
					G State Facility's ID		
					H Facility's Phone		
11 US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)				12 Containers No. Type	13 Total Quantity	14 Unit Wt/Vol	I Waste No.
a							
b							
c							
d							
J Additional Descriptions for Materials Listed Above						K Handling Codes for Wastes Listed Above	
15 Special Handling Instructions and Additional Information							
<p>16 GENERATOR'S CERTIFICATION I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled and are in all respects in proper condition for transport by highway according to applicable international and national government regulations.</p> <p>Unless I am a small quantity generator who has been exempted by statute or regulation from the duty to make a waste minimization or certification under Section 3002(b) of RCRA, I also certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and I have selected the method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment.</p>							
Printed/Typed Name				Signature		Month Day Year	
17 Transporter 1 Acknowledgement of Receipt of Materials							
Printed/Typed Name				Signature		Month Day Year	
18 Transporter 2 Acknowledgement of Receipt of Materials							
Printed/Typed Name				Signature		Month Day Year	
19 Discrepancy Indication Space							
20 Facility Owner or Operator Certification that the hazardous materials covered by this manifest except as noted on item 19							
Printed/Typed Name				Signature		Month Day Year	

Generator's Name

Transporter's Name

Facility's Name

Style F119-B Labelmaster DuPont America Labelmaster Co. Inc. 5/78

EPA Form 870-20 Rev. 4-84 Print on Recycled Paper

Figure 4. EPA's Uniform Hazardous Waste Manifest.

reached the disposal site. Thus, an EPA hazardous waste manifest (form 8700-22 and 8700-22A when needed) must be prepared according to 40 CFR 262.20 before any transport, transfer, or delivery of hazardous waste is made on a public highway. This manifest must be signed, dated, and given to the carrier by the shipper. A hazardous waste manifest (required by 40 CFR 262), containing all the information required by this subpart, may be used as the shipping paper required by 49 CFR 172.

5. Cargo Movement Operations System

The Cargo Movement Operations System (CMOS) is a major AF transportation automated data processing equipment project that will standardize and automate transportation cargo movement and crisis mobility procedures in the AF. The Program Management Directive (PMD) for CMOS development was approved by the Air Staff on 6 December 1985 [PMD 5272(1)/38610/F]. The system is being developed by the Standard Systems Center, Cunter AFB, Alabama.

CMOS will incorporate policies, procedures, and reporting structure used to plan, process, ship, and provide movement information necessary for visibility of AF base level military cargo shipments in both peacetime and wartime. Through automation of procedures outlined in AF Mobility Planning (AFR 28-4), Transportation of Material (AFR 75-1), and Military Standard Transportation and Movement Procedures (DOD 4500, 32R), CMOS will support the entire scope of cargo operations upon receipt of material from supply through delivery to the end user.

Initially, CMOS will implement a baseline transportation system using minicomputer and bar-code/laser-scanning technology. Follow-up on developments will include automation of hazardous cargo, mode-carrier selection, and electronic data interchange capability.

E. HAZMATs CLASSIFICATION SYSTEMS

1. Air Force HAZMAT Classification System

The BEE has the authority and responsibility to provide the classification of hazard for materials purchased and used on an AF base. Results of the site visits to four bases indicated that considerable variation in classification may exist. Three bases use an IEX system, which assigns codes of 8, 9, or no coding. The fourth base uses National Fire Protection Association (NFPA) codes (described below) or simply relies on the MSDS. Even where the numerical codes are used to regulate the purchases of certain materials and the conditions under which they can be used, considerable discretion is left to the person in charge.

BEE controls IEX-8 or IEX-9 code items at three of the bases visited. An IEX-8 code item is monitored by BEE through a postissue notification form DD 1348-1, which is used to track materials that can

affect the environment. IEX-9 code items are controlled by preissue approval from BEE, which either approves or disapproves the issue. This system is built on a close interface between Base Supply and BEE and enables BEE to control toxic substances that should be used only by qualified shops. A Form DD 1348-1 is completed so the toxic item can be further monitored.

The purpose of the IEX classification code is to identify and allow tracking of selected HAZMATs. If the nomenclature of a mixture does not identify its components, DOD 6050.5LR, AFR 71-3, or MSDSs are examined to determine its components. At Andrews AFB, components are examined for IEX coding with the following concepts in mind: quantity within unit of issue, quantities used or wanted, percentage of each component in the material, and toxicity of the components and the material itself. Points to consider related to the toxicity of a material are included below.

- a. Is it carcinogenic, mutagenic, or teratogenic?
- b. Could misuse of the product cause immediate adverse effects due to its acute toxicity?
- c. Is chronic toxicity a less immediate concern because illness is seen only after repeated exposure and after many years?
- d. Is it radioactive?
- e. What are the NFPA health ratings and permissible exposure levels?
- f. What are the effects of overexposure to the components in relation to the overall product?
- g. What is the rationale underlying the exposure limits?
- h. Does the product have a short-term exposure level or ceiling level and why?
- i. How does exposure occur?
- j. Would high or low dosage be expected with overexposure?
- k. What is the potential for airborne exposure?
- l. Will the product be used for spraying, brushing or dipping?
- m. Do the operations using the material require heating or cooling?
- n. Will the product be used for grinding, sanding, or buffing?
- o. What is the hazard index?

- p. Does the paint or coating contain lead?
- q. Is the material a pesticide or herbicide?
- r. Does the material contain asbestos?
- s. Under what conditions is the material used?
- t. Is the material used continuously or intermittently?
- u. What engineering controls or administrative procedures are used to minimize exposure to the material?
- v. Is protective clothing needed?

The general guidance provided at Andrews AFB is that the following should be given an IEX-9 code:

- a. any controlled pesticide or herbicide,
- b. radioactive material that requires a permit or letter from the user,
- c. other materials including isocyanate paint and coatings,
- d. lead based and zinc chromate paints,
- e. asbestos and asbestos containing material.

An IEX-8 code should be considered for potentially hazardous materials that are potentially hazardous but not to the point of requiring protective equipment.

An elaborate (formalized) process employed for determining materials classification takes place at Tinker AFB where the diversity of chemicals is perhaps also the greatest. The flow sheet incorporating the decision logic is seen in Figure 5. Materials with time-weighted-average (TWA) exposure levels greater than 150 ppm, are essentially unclassified with regard to toxicity. It is not evident what would be done for those materials without an identified TWA. An interesting feature of this Tinker AFB methodology is that it does provide a method to evaluate mixtures.

One of the bases visited has a number of tenants. Hanscom AFB hosts the Lincoln Laboratories and Rome Air Development Center (RADC). The host maintains all of the functions of a base including BEE. HAZMATs handled through normal channels are classified by BEE as an IEX-8, IEX-9, or not coded. Hanscom AFB uses many local purchase items; in addition, Lincoln Laboratories has its own purchasing department in association with Massachusetts Institute of Technology, its parent institution. RADC classifies its own materials during the approval-to-buy process. Currently they have the following codes: H (hazard), SE

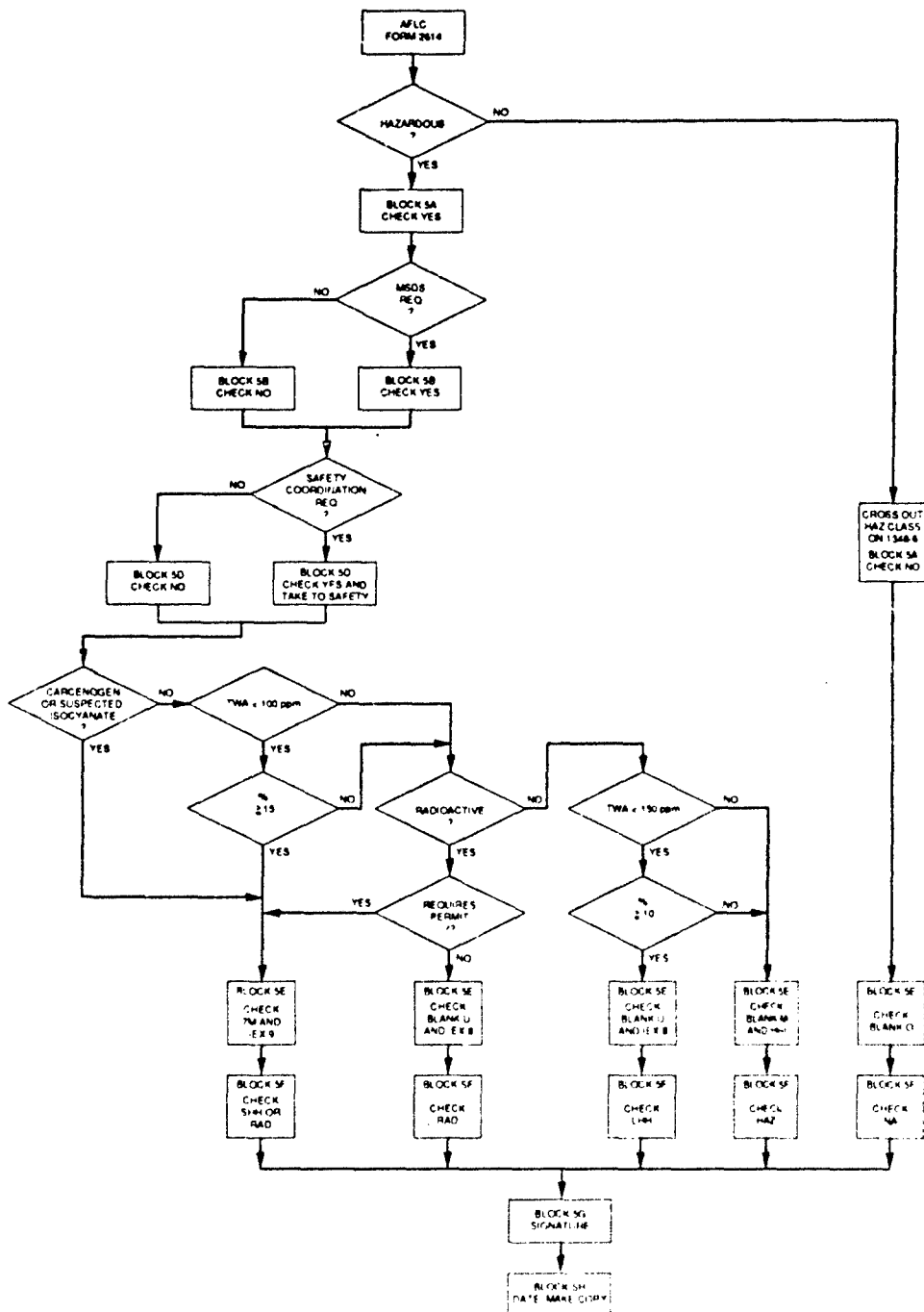


Figure 5. Tinker AF Base Bioenvironmental Engineering Flowsheet for Classifying Hazardous Materials.

(safety equipment), and NA (not applicable). Most chemicals are assigned an H, and a copy of each assignment is sent to the BEE.

2. Other Classification Systems

a. DOT Hazard Classification System

Definitions for the DOT hazard classes are as follows (49 CFR 173 and AFOSH Standard 127-68). These hazards are illustrated in Figures 1 and 2.

(1) Class A explosive. An explosive possessing detonating or otherwise maximum hazard. The nine types of Class A explosives are defined in Section 173.53.

(2) Class B explosive. An explosive possessing flammability hazard - In general, functions by rapid burning rather than detonation. Includes some explosive devices such as special fireworks, flash powders, etc. (Section 173.88).

(3) Class C explosive. An explosive of minimum hazard - Certain types of fireworks and certain types of manufactured articles containing restricted quantities of Class A and/or Class B explosives as components (Section 173.100).

(4) Blasting agent. A material designed for blasting which has been tested in accordance with Section 173.114a(b). It must be so insensitive that there is very little probability of: (1) accidental explosion or (2) going from burning to detonation.

(5) Combustible liquid. Any liquid having a flashpoint at or above 100°F and below 200°F. Authorized flashpoint methods are listed in Section 113.115(d). Exceptions are found in Section 113.115(b).

(6) Corrosive material. Any liquid or solid that causes visible destruction or irreversible damage to human skin tissue. Also, it may be a liquid that has a severe corrosion rate on steel [see Section 173.240(a) and (b) for details].

(7) Flammable liquid. Any liquid having a flashpoint below 100°F. Authorized flashpoint methods are listed in Section 173.115(d). For exceptions, see Section 173.115(a).

(8) Flammable gas. Any compressed gas meeting criteria as specified in Section 114.200(b). This includes: lower flammability limit, flammability limit range, flame projection, or flame propagation.

(9) Flammable solid. Any solid material (other than an explosive) which is liable to cause fires through friction or retained heat from manufacturing or processing. It can be ignited readily and burns so vigorously and persistently as to create a serious

transportation hazard. Included in this class are spontaneously combustible and water-reactive materials [Section 173.150].

(10) Organic peroxide. An organic compound containing the bivalent -O-O- structure. It may be considered a derivative of hydrogen peroxide where one more of the hydrogen atoms have been replaced by organic radicals. It must be classified as an organic peroxide unless it meets criteria listed in Section 173.15(a).

(11) Oxidizer. A substance such as chlorate, permanganate, inorganic peroxide or a nitrate that yields oxygen readily. It accelerates the combustion of organic matter [Section 173.151].

(12) Poison A. Extremely Dangerous Poisons - Poisonous gases or liquids - a very small amount of the gas or vapor of the liquid mixed with air is dangerous to life [Section 173.326].

(13) Poison B. Less Dangerous Poisons - Substances, liquids or solids (including pastes and semisolids), other than Class A or irritating materials - so toxic or presumed to be toxic to man that they are a hazard to health during transportation [Section 173.381].

(14) Irritating material. A liquid or solid substance which, upon contact with fire or air, gives off dangerous or intensely irritating fumes. This category does not include any poisonous material, Class A [Section 173.381].

(15) Etiological agent. A living microorganism (or its toxin) which causes (or may cause) human disease [Section 173.386].

(16) Radioactive material. Any material, or combination of materials, that spontaneously gives off ionizing radiation. It has a specific activity greater than 0.002 microcuries per gram [Section 173.389 (a) through (1) for details].

(17) ORM (Other regulated material). (1) Any material that may pose an unreasonable risk to health and safety or property when transported in commerce; and (2) does not meet any of the definitions of the other hazard classes specified in this subpart; or (3) has been reclassified an ORM (specifically or permissively) according to this subchapter [Section 173.500(a) (1)].

(18) ORM-A. A material which has an anesthetic irritating, noxious, toxic, or similar property. If the material leaks during transportation, passengers and crew would experience extreme annoyance and discomfort [Section 173.500(b)(1)].

(19) ORM-B. A material (including a solid when wet with water) the leakage of which could cause significant damage to the vehicle transporting it. Materials meeting one or both of the following criteria are ORM-B materials: (1) specifically designated by name in Section 172.101 and/or (2) a liquid substance that has a corrosion rate

exceeding 0.250 inch per year on nonclad aluminum at a test temperature of 130°F [Section 173.500(b)(2)].

(20) ORM-C. A material which has inherent characteristics not described as an ORM-A or ORM-B. It is unsuitable for shipment unless properly identified and prepared for transportation. Each ORM-C material is specifically named in Section 172.101 [Section 173.500(b)(3)].

(21) ORM-D. A material such as a consumer commodity which presents a limited hazard during transportation because of its form, quantity and packaging. They must be materials for which exceptions are provided in Section 172.101. A shipping description applicable to ORM-D material if found in Section 172.101 [Section 173.500 (b)(4)].

(22) ORM-E. A material not included in any other hazard class, but subject to the requirements of this subchapter.

Materials in this class include (1) Hazardous Wastes and (2) Hazardous Substances, as defined in Section 171.8 [Section 173.500 (b)(5)].

The following additional DOT definitions are included to explain some of the other hazards:

(1) Compressed gas. Any material or mixture having a container pressure exceeding 40 psia at 130°F, or exceeding 104 psia at 130°F, or any liquid flammable material having a vapor pressure exceeding 40 psia at 100°F [Section 173.300(a)].

(2) Nonliquified compressed gas. A gas (other than gas in solution) which, under the charged pressure, is entirely gaseous at a temperature of 70°F.

(3) Liquified compressed gas. A gas which, under the charged pressure, is partially liquid at a temperature of 70°F.

(4) Compressed gas in solution. A compressed gas which is dissolved in a solvent.

(5) Nonflammable gas. Any compressed gas other than a flammable compressed gas.

(6) Spontaneously combustible material, solid. A solid substance (including sludges and pastes) which may undergo spontaneous heating or self-burning under normal transportation conditions. These materials may increase in temperature and ignite when exposed to air [Section 171.8].

(7) Water reactive material, solid. Any solid substance (including sludges and pastes) which react with water by igniting or giving off dangerous quantities of flammable or toxic gases [Section 171.8].

b. National Fire Protection Association System

The NFPA has widely used and recognized classification prepared by the Technical Committee on Fire Hazards of Materials. The purpose of the classification is to safeguard the lives of those individuals who may be concerned with fires occurring in an industrial plant or storage location where the fire hazards of materials may not be readily apparent. This classification provides a simple marking system that is easily read and understood. Properties dealt with are health, flammability, reactivity, and special reactivity. A numerical system is used to show the range of the hazard from 4, which indicates a severe hazard (life threatening), to 0 (zero), which indicates no special hazard. The system of ranking the degree of hazard is relative rather than absolute. Explanation of NFPA hazard classification is provided in Table 3.

Health hazard ranking is determined by degree of hazard and the protective measures that are needed to minimize hazards of short-term exposure. The two sources of health hazards are inherent properties of the material and the toxic products of combustion upon decomposition of the material. The hazard ranking depends on which source of hazard is greater. The ranking number tells the fire department personnel dealing with the hazard whether specialized equipment is needed and if suitable respiratory protective equipment is required or ordinary clothing can be worn.

The NFPA hazard classification system is illustrated in Figure 6.

c. Industrial hygiene hazard classification

An industrial hygiene hazard classification system has been developed at ORNL. This health hazard classification system is based on threshold limit value (TLV) or mean lethal dose (LD_{50}) and mean lethal concentration (LC_{50}). A four to zero classification is used: 4 is extremely hazardous, 3 is highly hazardous, 2 is moderately hazardous, 1 is slightly hazardous, and 0 is relatively harmless. The classification based on TLVs is listed below.

Health Rating	Common Term	TLV	
		ppm	mg/m ³
4	Extremely hazardous	<1	<0.25
3	Highly hazardous	1-10	0.26-2.5
2	Moderately hazardous	11-250	2.6-5.0
1			
0	Relatively harmless	>1000	>10

TABLE 3. EXPLANATION OF NATIONAL FIRE PROTECTION ASSOCIATION HAZARD CLASSIFICATIONS.

Classification	
Health Hazard (blue)	
4	Materials which on very short exposure could cause death or major residual injury even though prompt medical treatment were given.
3	Materials which on short exposure could cause serious temporary or residual injury even though prompt medical treatment were given.
2	Materials which on intense or continued exposure could cause temporary incapacitation or possible residual injury unless prompt medical treatment is given.
1	Materials which on exposure would cause irritation but only minor residual injury even if no treatment is given.
0	Materials which on exposure under fire conditions would offer no hazard beyond that of ordinary combustible material.
Flammability (red)	
4	Materials which will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature, or which are readily dispersed in air and which will burn readily.
3	Liquids and solids that can be ignited under almost all ambient temperature conditions.
2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.
1	Materials that must be preheated before ignition can occur.
0	Materials that will not burn.
Reactivity (yellow)	
4	Materials which in themselves are readily capable of detonation or of explosive decomposition or reaction at normal temperatures and pressures.
3	Materials which in themselves are capable of detonation or explosive reaction but require a strong initiating source or which must be heated under confinement before initiation or which react explosively with water.
2	Materials which in themselves are normally unstable and readily undergo violent chemical change but do not detonate. Also materials which may react violently with water or which may form potentially explosive mixtures with water.
1	Materials which in themselves are normally stable, but which can become unstable at elevated temperatures and pressures or which may react with water with some release of energy but not violently.
0	Materials which in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.
Other (white)	
W	Materials which react so violently with water that a possible hazard results when they come in contact with water, as in a fire situation. Similar to Reactivity Classification 2.
Oxy	Oxidizing material; any solid or liquid that readily yields oxygen or other oxidizing gas, or that readily reacts to oxidize combustible materials.

Source: "Fire Protection Guide on Hazardous Materials," 7th ed., National Fire Protection Association, Boston, Mass., 1978.

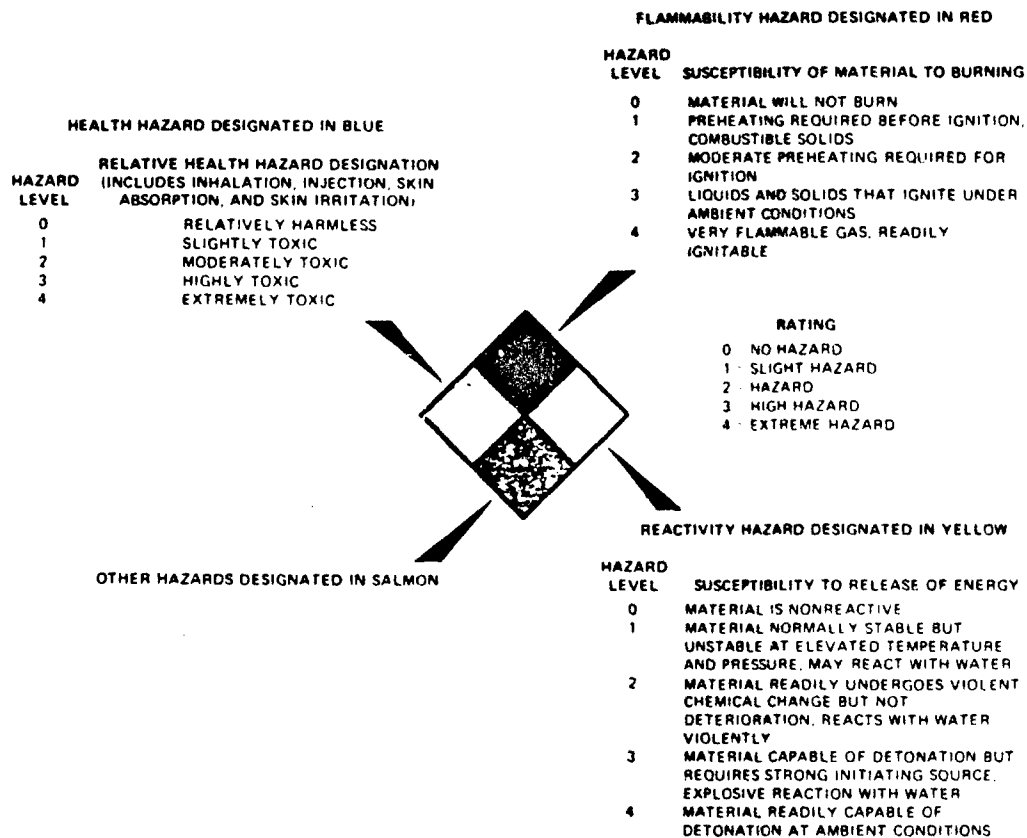


Figure 6. Hazard Rating Scheme of the National Fire Protection Association.

Health rating classifications based on LD₅₀ and LC₅₀ values are:

(1) Rating of 4:

Acute: exposure may be potentially life-threatening

Chronic: exposure may be potentially life-threatening
(includes human carcinogens, mutagens, and teratogens)

LD₅₀ oral rat dose (mg/kg) = ≤ 1

LD₅₀ inhalation 4 h vapor rats (ppm) = ≤ 10

LD₅₀ rabbit skin (mg/kg) = ≤ 5

(2) Rating of 3:

Acute: major temporary or permanent injury may threaten life

Chronic: major permanent injury (includes animal carcinogens, mutagens, and teratogens)

LD₅₀ oral rat dose (mg/kg) = 1.1 to 50 (OSHA considers highly toxic)

LC₅₀ inhalation 4 h vapor rats (ppm) = 11 to 100

LD₅₀ rabbit skin (mg/kg) = 5.1 to 43

(3) Rating of 2:

Acute: minor temporary or permanent injury (includes nonlife-threatening substances to which the majority of exposed are sensitive)

Chronic: minor temporary or permanent injury

LD₅₀ oral rat dose (mg/kg) = 50.1 to 500 (OSHA considers toxic)

LC₅₀ inhalation 4 h vapor rats (ppm) = 101 to 1000
(OSHA considers highly toxic at 200)

LD₅₀ rabbit skin (mg/kg) = 44 to 340 (OSHA considers highly toxic at 200)

(4) Rating of 1:

Acute: minor injury readily reversible

Chronic: minor injury readily reversible, asphyxiants

LD₅₀ oral rat dose (mg/kg) = 510 to 1500

LC₅₀ inhalation 4 h vapor rats (ppm) = 1001 to 100,000
(OSHA considers toxic 200 to 2000)

LD₅₀ rabbit skin (mg/kg) = 350 to 22,600 (OSHA considers toxic 200 to 2000)

(5) Rating of 0:

Acute and chronic: materials that produce toxic effects only under the most unusual conditions or by overwhelming dosage

LD₅₀ oral rat dose (mg/kg) = >15,000

LC₅₀ inhalation 4 h vapor rats (ppm) = >100,000

LD₅₀ rabbit skin (mg/kg) = >22,600

d. Proposed Department of Defense Hazard Warning Labeling System

The DOD has a proposed hazard warning labeling system. This system was developed to comply with the OSHA Hazard Communication Standard (HCS) and to meet labeling needs within the federal sector. The proposed hazard warning label and data element descriptors were developed for use as a uniform labeling system to meet the labeling requirements within DOD for:

- (1) Improperly labeled HAZMATs,
- (2) Unlabeled HAZMATs,
- (3) HAZMATs manufactured within DOD, and
- (4) Repackaging of bulk quantities of HAZMATs.

The system uses American National Standard Institute (ANSI) language, including signal words, and statement of hazard and precautionary measures. It is not intended to be used to relabel HAZMATs bearing the manufacturer's hazard warning label.

The proposed DOD HAZMAT label contains health hazard ratings based on oral and inhalation data for the rat and dermal as well as eye irritation data for the rabbit. This system uses four levels of rating from none to severe and is similar to the five-level industrial hygiene hazard classification system developed at ORNL (described immediately above). The four hazard indicators are health, contact, fire, and reactivity (Figure 7).

① Chemical/Common Name
NSN/LSN
Item Name





Part Number

Storage Code

② HAZARDS

IMMEDIATE

DELAYED

		NONE	SLIGHT	MODERATE	SEVERE
HEALTH		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CONTACT		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
FIRE		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
REACTIVITY		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

③ HEALTH HAZARDS (INCLUDING TARGET ORGAN EFFECTS)

④ PROTECT: EYE ☐ SKIN ☐ RESPIRATORY ☐

⑤ Name
Address
Emergency Telephone

See MSDS for Further Information

DO FORM _____

YEAR _____

Figure 7. Four Hazard Indicators.

The four levels of rating are described below.

(1) None

- No significant health hazard.
- Materials which produce toxic effects only under the most unusual conditions or by overwhelming dosage.

(2) Slight Hazard (Signal Word - CAUTION!)

- No severe or permanent damage to affected person.
- No reduction of affected person's physical or mental ability to respond appropriately to an emergency.

Examples: Nausea; headache; skin defatting; mild irritation of skin, eyes, and respiratory tract; coughing.

(3) Moderate Hazard (Signal Word - WARNING!)

- No severe or permanent damage to affected person.
- Possible reduction of affected person's physical or mental ability to respond appropriately to an emergency.

Examples: dizziness, temporary loss of sight, mental confusion, severe abdominal pain, first-degree skin burns, temporary cardiac arrhythmia, loss of coordination, central nervous system depression.

(4) Severe Hazard (Signal Word - DANGER!)

- Severe or permanent damage, or fatal to affected person.

Examples: loss of consciousness; cardiac arrest; convulsions; severe burns to skin, eyes, and respiratory tract; coma; damage to organs; death.

e. Relative Potency Classification System

Relative potency classification is adopted by the AF for assistance in Phase II evaluation during the IRP. Beginning in September 1988, it is slated for use by all of the DOD in ranking IRP sites. This work, performed by ORNL for the AF Occupational and Environmental Health Laboratory at Brooks AFB. It incorporates a new feature in hazard ranking (Reference 3). The newly developed hazard ranking system is based on a relative potency framework for the health hazard. By using this framework, any chemical for which some toxicological data are available can be ranked for toxicity hazard relative to a well-studied chemical or chemicals. Unlike the systems described

above, a wide range of toxicological data may be used in a manner not requiring assumptions to be made in interpreting data, thereby allowing ranking even when specified LD₅₀ data are not available.

The value of the relative potency hazard ranking system is that it can be applied routinely by someone without a degree in toxicology. Thus, every chemical would be scored the same at all AF bases, eliminating variations in classification. The hazard rank of a new material can then be compared with hazard ranks of a few well-studied benchmark chemicals for which there is extensive human toxicological data. On the basis of hazard level and action guidelines developed for the well-studied benchmarks, the hazard level and action guidelines can be determined for the new chemical even when limited toxicological data are available. This is the only health hazard ranking system identified that provides for a continuous ranking of potency, that can be used for acute and chronic end points, and that can make use of a wide range of available toxicological data.

F. EXISTING INTERFACE BETWEEN THE USERS AND THE RESPONDING ACTION AGENCIES AT HAZMAT EMERGENCIES

This section addresses the results from an examination and evaluation of the existing interface between the users of HAZMATs and the responding agencies during HAZMAT incidents. It primarily covers the roles and responsibilities of the AF fire departments. No HAZMAT emergencies or drills were actually observed. The information is gathered from site visits and published documents.

This section is divided into five subsections: relevant literature; spill prevention and response (SPR) plans, spill committees, and disaster preparedness operations (DPO) plans; descriptions provided by the fire chiefs and HAZMAT incident response team leaders of the interface during HAZMAT emergencies; and other information obtained from the visits to the AF fire departments.

1. Relevant Literature

a. Headquarters, AF/LEE Letter*

AF Headquarters wrote a letter to all major command fire departments in regard to HAZMAT incidents involvement. Paragraph 2 of the letter stated that the fire protection role should be viewed as providing on-scene command and control, onsite rescue, fire extinguishment, and stabilization of the HAZMAT. Once the HAZMAT is neutralized, fire department involvement should revert to a support role. Recovery,

*See footnote Section IIB.

cleanup, and disposition of the HAZMAT should be accomplished by other base agencies.

b. AFOSH Standard 127-68

AFOSH Standard 127-68 addresses AF chemical storage, handling, and use and disposal operations. The criteria in the standard are the minimum safety, fire prevention, and occupational health requirements of the AF.

Paragraph 5(f) covers the AF's emergency response to chemical spills. The following is iterated:

(1) In their SPR plan, each base is to identify a team to respond effectively to chemical spills. The makeup of the team may vary by command and by the needs of a particular disaster or emergency. Recommended composition of the spill response team (SRT) is the fire department, BEE, health physics advisor, and base EC.

(2) In all responses, priority should be given first to life saving and injury treatment and then to spill control.

(3) Use and type of protective garments and sampling techniques should be determined by the BEE.

c. Guidance Manual for the Preparation of SPR Plans (Reference 4)

An SPR plan is a combination of the Spill Prevention, Control, and Countermeasures (SPCC) plan, the Oil and Hazardous Substance Pollution Contingency (OHSPC) plan, and the Hazardous Waste Contingency plan. An SPCC plan is required by 40 CFR 112.7 and is to designate and describe the spill prevention procedures, methods, and equipment incorporated into base oil and hazardous substance facilities. An OHSPC plan is a requirement for all federal installations under the National Contingency Plan (40 CFR 330.33). The plan presents spill response procedures and the personnel, organizations, and equipment that should be utilized in response efforts. The hazardous waste contingency plan is required by 40 CFR 264.50-56 and is designed to minimize hazards to human health or to the environment from fires, explosions, or any unplanned sudden or nonsudden release of hazardous waste.

The manual recommends that the SPR plan be developed by a subcommittee of the EPC to be referred to as the "Spill Committee." The membership of the Spill Committee should include the Base Civil Engineer (BCE) as the chairman, the fire chief, the BEE, the base fuels management officer and the base environmental coordinator.

Section 4.2 of the guidance manual states that the SRT should be composed of primarily on-base organizations supplemented by off-base organizations when base resources are insufficient or off-base response actions are required. The SRT is to be directed and

coordinated by an on-scene coordinator (OSC). The manual recommends that the Base Commander or Vice Commander be the OSC and that the BCE and fire chief be first and second alternates, respectively. The members of the team should be predetermined and responsibilities assigned based on available resources. All organizations included in the SRT are to develop procedures for initiating their response actions.

Suggested base organizations to be included on the SRT during an emergency are: the fire department, security police, CE, BEE, public affairs office, base medical treatment facility, transportation squadron, weather squadron, and disaster preparedness office. The recommended responsibilities for the fire department are as follows.

(1) If a fire hazard is involved, respond immediately to an actual or potential HAZMAT spill in accordance with established procedures.

(2) Direct operations at the spill site until the OSC arrives and assumes command of the situation.

(3) Provide technical assistance to the OSC in response to and in the handling of combustible or flammable substances.

(4) Provide available fire department personnel with protective clothing and equipment.

Section 4.3 of the guidance manual identifies four types of spill response procedures that should be developed (for each AF base) and designated in the SPR plan. The SPR plan procedures should include: initial spill response procedures, spill communications network operating procedures, general spill response procedures, and site-specific response procedures.

(1) Initial spill response procedures. Initial response to a HAZMAT spill consists of immediate defensive actions that should be taken by individuals discovering it or its potential. These actions can be categorized as site-specific and general response actions. The site-specific actions include such things as the knowledge of locations of fire extinguishers, alarm systems, or absorbants. The general response actions are those appropriate for virtually all potential spill sites and include initial response actions and spill reporting requirements. These are summarized in Figure 8 (Figure 4.4 of the manual).

(2) Spill communications network operating procedures. In the SPR plan, each AF base should establish and designate a spill reporting center to receive initial reports. The manual recommends that the fire department be assigned to this position. The communications network operating procedures should include requirements for documenting all relevant information during a spill report and an SRT notification sequence. An example of these procedures is presented in Figure 9 (Figure 4.5 of the manual). The notification sequence will depend somewhat on the structure of the base response team; however, the following sequence was suggested in the manual by Engineering-Science, Inc.

EXAMPLE
SPILL REPORTING CENTER LOG SHEET

I. INITIAL INFORMATION REQUIRED:

Name of informant: _____

Location of spill: _____

Number of injured and type of injuries (if applicable): _____

Substance spilled: _____

Amount spilled (estimated): _____

Extent of spill: _____

Rate material currently spilling (estimated): _____

Time spill occurred (estimated): _____

Time of notification: _____

Other information: _____

II. SRT NOTIFICATION SEQUENCE

1. Base Hospital (If personnel injured) Time _____
24 Hours: Ext.

2. Base Fire Department (If flammable liquids present) 24 Hours: Ext. Time _____

3. Environmental Coordinator Time _____
Duty Hrs: Ext.
Non-Duty Hrs (optional): Ext.

4. Base Fire Chief (If Environmental Coordinator unavailable) Time _____
24 Hours: Ext.

Figure 8. Spill Reporting Center Log Sheet.

RECOMMENDED

INITIAL SPILL RESPONSE AND
NOTIFICATION PROCEDURES

- I. In the event of a spill the following actions should be taken.
The order of the actions will depend on existing conditions.
 - o Institute evacuation procedures, if applicable.
 - o Notify base spill reporting center. Telephone number ____.
 - o Stop source of spill when possible without undue risk of personal injury. This includes use of on-site spill containment equipment and materials.
 - o Make spill scene OFF LIMITS to unauthorized personnel.
 - o Restrict all sources of ignition when flammable substances are involved.
 - o Report to on-scene coordinator and provide assistance until response team is fully operational.
- II. When notifying base spill response center, provide the following information:
 - o Your name.
 - o Location of spill and facility number if known.
 - o Number of injured personnel and nature of injuries (if applicable).
 - o Substance spilled.
 - o Amount spilled (estimated).
 - o Extent of spill.
 - o Rate material currently spilling (estimated).
 - o Time spill occurred (estimated).
 - o Any other pertinent information.

Figure 9. Recommended Initial Spill Response and Notification Procedures in the Guidance Manual by Engineering-Science, Inc.

The base hospital (if personnel are reported injured) and the fire department (if a potential fire hazard exists) should be notified first. The BCE should be notified next. The BCE would then be responsible for initially investigating the spill and notifying the OSC if a reportable spill has occurred or could occur. The BCE would also be responsible for making recommendations to the OSC concerning the nature of response actions to be initiated and the members of the SRT to be activated. If the BCE is unavailable, the fire chief should assume the responsibilities. The OSC should be notified directly of spills of a potentially catastrophic nature. Any disaster response alert procedures would also be implemented.

(3) General spill response procedures. If a HAZMAT is spilled or released, the OSC should be solely responsible for directing and coordinating all emergency response actions. The recommended sequence of actions to be taken by the OSC should be designated in the SPR plan.

(4) Site-specific contingency plan preparation. Site-specific contingency plans should be prepared for sites with significant historical spills; bulk HAZMAT loading and unloading sites; hazardous waste accumulation and storage sites; and any additional sites deemed by the OSC to have significant spill potential and/or potential for serious health or environmental impacts. The information that should be included in the contingency plan is as follows:

- Evacuation procedures to be initiated in the event of a spill.
- Initial spill response actions that can be taken by individual(s) discovering a spill.
- Probable spill route and the locations where spill containment could be implemented.
- Specific actions to be taken by the individual members of the response team.
- Applicable MSDS.
- Special notification requirements and procedures.
- Disposal and decontamination procedures for spill material and contaminated soil, water, and equipment.

d. AFLC Regulation 161-1

AFLC Regulation 161-1 establishes policy and assigns responsibilities for the management of HAZMATs at AFLC bases. Two paragraphs of this document deal specifically with HAZMAT spills. The first (paragraph 5.k) states that when HAZMATs are involved in fires, spills, leaks, or otherwise uncontrolled/unintentional releases, the using

activity will be responsible for cleanup of known materials in quantities less than reportable limits defined in local regulations. All other spills will be reported to and managed by the AF base in accordance with the SPCC plan. The other citation [paragraph 6.b(7)(h)] says that organizations/activities using HAZMATs should develop chemical spill response procedures to cleanup small quantities, to recognize and report spills, and to assist the base spill response team.

e. AF Regulation 355-1

AF Regulation 355-1 provides policies and explains procedures for planning and operating the AF disaster preparedness program. It outlines the organizational structure at each level of command and assigns base-wide responsibilities for the conduct of local programs.

Paragraph 3-4 of the document states that all AF installations must write a DPO plan. The purpose of the plan is to provide comprehensive guidance for the response to emergency or disaster situations. However, paragraph 8-2 states that a hazardous substance spill is governed by this plan only if the situation is a potential or actual major accident or escalates into one. The President of the United States or the Federal Emergency Management Agency will determine if and when a chemical spill becomes a major accident.

Paragraph 2-15 describes the responsibilities of the on-scene disaster response group (DRG). This group is to respond to the scene of an accident to provide command and control. The composition and responsibilities of the DRG will vary with the resources, capabilities, and mission of each installation. Members are to advise the OSC of actions to be taken. The group is to be made up of the following individuals: fire chief, OSC, security police, CE, BEE, public affairs, medical services, transportation, and weather contracting officer. The fire chief is to: take command until a designated OSC arrives (in the absence of the fire chief, the senior firefighter will serve in this capacity); designate the initial entry control point location; direct all firefighting and rescue operations; upon arrival of the designated OSC, serve as the technical advisor and brief the status of the incident to the OSC; and coordinate with local firefighting officials for mutual response requirements.

Paragraph 8-5.b of the document identifies the rescue and firefighting procedures. The fire department is to: use appropriate equipment; approach the accident scene from the upwind or crosswind side; and perform rescue, lifesaving, and hazard suppression and containment.

Attachment 3 of the document presents a set of checklists for each of the individuals making up the DRG. Paragraph 3-4.a of the attachment presents the immediate actions for the fire department in regard to on-base accidents. The fire department is to:

(1) obtain available information about the accident and ensure that it is reported to the command post.

(2) proceed to the accident site.

(3) ensure that actions are being taken to: remove and treat medical casualties, perform firefighting and rescue operations, and evacuate the area.

(4) notify security police of the designated location to set up an entry control point.

(5) shutdown utilities as required.

(6) sound withdrawal when appropriate.

(7) park withdrawing vehicles inside the cordon.

(8) assume the on-scene command, in the absence of the OSC.

(9) brief the OSC on the nature of the accident, the number of military and civilian medical casualties, property damage, and the need for assistance.

Paragraphs 3-4.c and d present the checklists for follow-on fire units and recovery actions, respectively. Follow-on fire units are to: report to the convoy assembly area; secure equipment; attend the road convoy briefing; proceed in convoy to the accident scene; and upon arrival, transmit status and location to the fire chief. During recovery actions, the fire department is to: have firefighters and fire vehicles checked for contamination; take part in the development of a recovery plan, if required; and ensure that actions are taken to reserve firefighting vehicles.

2. Spill Prevention Response (SPR) Plans, Spill Committees, and Disaster

Preparedness Operations (DPO) Plans

a. Andrews AFB

(1) SPR plan. Andrews AF base has a draft SPR plan that specifies, among other things, the procedures to be followed when a hazardous substance spill occurs within, discharges from, or encroaches upon the physical boundaries of the base. These include spill detection reporting, containment, cleanup, and disposal practices. The plan is to be implemented upon notification of an actual or potential HAZMAT spill. The execution of the plan is divided into five phases. Phase I (discovery and initial notification) covers actions to: discover the spill or potential spill, locate the spill and the danger to nearby resources, determine the type and amount of pollutant, and report the spill. Phase II (containment and countermeasures) deals with those

actions taken to contain the spill as soon as the spill is discovered or reported. If there is any threat to life or property due to a HAZMAT, this phase is under the direction of the senior fire officer (SFO) acting as the OSC. Phase III (cleanup and disposal) addresses those actions taken to remove the pollutants from the water and related on-shore areas and to dispose of the pollutants recovered. The fire department's role during this phase primarily is support. Phase IV (restoration) encompasses those actions taken to restore the environment to its prespill condition and to assess the damage caused by the spill. Phase V (recovery of damages and enforcement) includes the recovery from damage done to federal property and the collection of scientific and technical information.

Any person discovering a spill on Andrews AFB will: initiate evacuation, if necessary; notify the fire department; stop the source of the spill when possible without undue risk of personal injury; make the spill scene off limits to personnel; restrict all sources of ignition when flammable, combustible, or oxidizing agents are involved; and, upon his arrival, report to the OSC.

The HAZMAT incident response team is made up of the OSC and both civilian and military personnel from the fire department, CE, security police, BCE, BEE, photography, public affairs, staff judge advocate, and maintenance.

Upon notification of a spill the fire department will immediately respond to an actual or potential HAZMAT spill and notify the CE service desk. Upon arrival at the scene, the fire department will take the necessary steps to control all conditions hazardous to life or property in accordance with established fire procedures and/or any countermeasures available to control and contain the spill. The fire department will evaluate the spill and identify the substance spilled, amount spilled, area covered by the spill, location of spill, and spill surface. The fire chief will direct operations at the spill location while there is a threat to life and property. The HAZMAT will be flushed only as an emergency measure to prevent imminent danger to life or property. The fire department will provide technical assistance to the OSC in response and handling of a HAZMAT and will activate the mutual aid agreement with Prince Georges County when deemed necessary by the SFO on scene. Tabs A-G of Appendix 8 (special considerations for response to hazardous substances) to Annex G (spill response team activation procedures) of the SPR plan describe the HAZMAT incident response team members/groups (i.e., fire communications center operator, team leader, information sector, safety sector, reconnaissance sector, and decontamination sector and resource (tools) sector), details their functions and responsibilities and provides checklists for each of the team's component.

The fire communications center (FCC) operator records information from the person discovering the HAZMAT spill and dispatches equipment and personnel. The operator also assists response by planning the approach route for the response team. The team leader is

responsible for managing the HAZMAT incident using an Eight-Step Process (Reference 5). The steps are summarized as follows:

- (1) isolate the area and deny entry,
- (2) identify the hazardous substance(s),
- (3) evaluate the hazards and risks,
- (4) select protective clothing and equipment;
- (5) coordinate information and resources;
- (6) control the hazardous substance spill;
- (7) decontamination;
- (8) and termination.

The team leader responsibilities are:

- (1) to supervise the HAZMAT incident response team;
- (2) coordinate the activities of the information, safety, reconnaissance, decontamination, and resources sectors;
- (3) and assign personnel to the specific sectors. The team leader receives instructions from the OSC and keeps the OSC fully advised of technical and specific information relative to the incident.

The information sector is responsible for the assembly and analysis of all technical reference material, incident data, and other resources. It recommends preventing the immediate hazards to life (toxic, reactive, and flammable), evacuation distances, and the required level of protective clothing and equipment. The information sector coordinates with the team leader to identify the hazardous substance(s) involved. Once identified, this sector evaluates each substance via either a HAZMAT data sheet (Figure 10) or a sample hazardous substance information form (Figure 11), which is passed on to the team leader and the safety sector. The information sector contacts the CHEMTREC, the manufacturer, or the shipper as necessary and works closely with representatives from base agencies to obtain further technical information. This sector also works jointly with the decontamination officer to identify the required level of decontamination and the mitigation protocol and procedures.

The safety sector is responsible for ensuring that safe and accepted practices are adhered to throughout the course of the emergency. It sets up three perimeters (zones - hot, warm, and cold) and evaluates the positioning of the apparatus and personnel within the zones. This sector is also responsible for the welfare of all personnel operating in the hot and warm zones. The safety sector activities are conducted in accordance with the following.

Hazardous Material Data Sheet

Hazardous Material:

Shipping Name _____ DOT Hazard Class _____
 Chemical Name _____ ID Number _____ STCC Number _____

Physical Description:

Normal Physical Form: Solid _____ Liquid _____ Gas _____
 Color _____ Odor _____
 Other _____

Chemical Properties:

Specific Gravity _____ Vapor Density _____
 Boiling Point _____ °F Melting Point _____ °F
 Vapor Pressure _____ psi or mmHg at _____ °F Expansion Ratio _____
 Solubility: In water: Yes No Degree of solubility _____
 Other _____

Health Hazards:

☐ Yes ☐ No Inhalation Hazard: Yes No TLV/TWA _____ ppm(mg/m³) LC₅₀ _____ ppm/hr
☐ Yes ☐ No Ingestion Hazard: Yes No LD₅₀ _____ mg/kg
☐ Yes ☐ No Absorption Hazard: Yes No Skin: Yes No Eyes: Yes No
 IDLH Value _____ ppm air(mg/m³) STEL Value _____ ppm air(mg/m³)
 Chronic Hazard: Carcinogen: Yes No Mutagen: Yes No Teratogen: Yes No
 Hazardous to Aquatic Life: Yes No
 Other _____
 Decontamination Procedures _____
 First Aid Procedures _____

Fire Hazards:

☐ Yes ☐ No Flash Point _____ °F Ignition (Autoignition) Temperature _____ °F
☐ Yes ☐ No Flammable (Explosive) Range: LFL (LEL) _____ % UFL (UEL) _____ %
 Toxic Products of Combustion _____
 Other _____
 Possible Extinguishing Agents: _____

Reactivity Hazards:

☐ Yes ☐ No Reactive with what _____
☐ Yes ☐ No Other _____

Corrosivity Hazards:

☐ Yes ☐ No pH _____ Corrosive to what: Skin: Yes No Steel: Yes No Other _____
☐ Yes ☐ No Other _____
 Neutralizing Agents: _____

Radioactivity Hazards:

☐ Yes ☐ No Type Radiation Emitted: Alpha Particles _____ Beta Particles _____ Gamma Radiation _____
☐ Yes ☐ No Other _____

Recommended Protection:

For Public: Evacuation distance _____ for _____ (quantity) _____
 For Response Personnel: Level of protection required _____
 For Environment: _____

Figure 10. Hazardous Materials Data Sheet.

Sample Hazardous Substance Information Form

COMMON NAME: _____ CHEMICAL NAME: _____

I. PHYSICAL/CHEMICAL PROPERTIES

			SOURCE
Natural physical state: Gas _____ Liquid _____ Solid _____			
(at ambient temps of 20°C-25°C)			
Molecular weight _____		g/g-mole	
Density ^a _____		g/ml	
Specific gravity ^a _____	0	°P/°C	
Solubility: water _____	0	°P/°C	
Solubility ^b : _____	0	°P/°C	
Boiling point _____		°P/°C	
Melting point _____		°P/°C	
Vapor pressure _____	mmHg 0	°P/°C	
Vapor density _____	0	°P/°C	
Flash point _____		°P/°C	
(open cup _____; closed cup _____)			
Other: _____			

II. HAZARDOUS CHARACTERISTICS

A. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS (PEL, TLV, other)	SOURCE
Inhalation	Yes No	_____	_____
Ingestion	Yes No	_____	_____
Skin/eye absorption	Yes No	_____	_____
Skin/eye contact	Yes No	_____	_____
Carcinogenic	Yes No	_____	_____
Teratogenic	Yes No	_____	_____
Mutagenic	Yes No	_____	_____
Aquatic	Yes No	_____	_____
Other: _____	Yes No	_____	_____

B. TOXICOLOGICAL HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
Combustibility	Yes No	_____	_____
Toxic byproduct(s): _____	Yes No	_____	_____
_____		_____	_____
Flammability	Yes No	_____	_____
LPL		_____	_____
UPL		_____	_____
Explosivity	Yes No	_____	_____
LEL		_____	_____
UEL		_____	_____

^aOnly one is necessary.

^bFor organic compounds, recovery of spilled material by solvent extraction may require solubility data.

Figure 11. Sample Hazardous Substance Information Form.

C. REACTIVITY HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
	Yes No		
Reactivities:			
_____		_____	_____
_____		_____	_____
D. CORROSIVITY HAZARD	HAZARD?	CONCENTRATIONS	SOURCE
ph _____	Yes No		
Neutralizing agent:			
_____		_____	_____
_____		_____	_____
E. RADIOACTIVE HAZARD	HAZARD?	EXPOSURE RATE	SOURCE
Background	Yes No		
Alpha particles	Yes No	_____	_____
Beta particles	Yes No	_____	_____
Gamma radiation	Yes No	_____	_____
III. DESCRIPTION OF INCIDENT:			
Quantity involved _____			
Release information _____			

Monitoring/sampling recommended _____			

IV. RECOMMENDED PROTECTION:			
Worker _____			
Public _____			

V. RECOMMENDED SITE CONTROL:			
Hotline _____			

Decontamination line _____			

Command Post location _____			

VI. REFERENCES FOR SOURCES:			

Figure 11. Sample Hazardous Substance Information Form (Concluded).

- The safety officer is positioned in the warm zone at the entry into the hot zone.

- Entry into the hot zone is restricted to trained personnel and individuals possessing particular knowledge of the problem/situation of the hazardous substance(s).

- The safety sector is to remain in constant contact with the team leader, entry teams, and the OSC.

- The safety sector retains the authority to halt operations and to order personnel back to the warm zone if unsafe conditions are observed.

- The safety sector is to complete an incident exposure record (Figure 12).

The reconnaissance sector is responsible for developing information on the physical layout of the incident site in addition to other factors influencing the emergency. The task of this sector is to give the team leader and the OSC a complete picture of current and anticipated conditions. The reconnaissance sector will attempt to view the incident from all sides and coordinate all data gathering with the information sector.

The decontamination sector consists of a minimum of four personnel and a sector officer. The four personnel must be familiar with the decontamination process. The decontamination officer, along with the team leader and the information sector, determines what level of decontamination is required to ensure the safety of emergency personnel and civilians. The decontamination officer establishes an isolated area for the removal of harmful substances from emergency response personnel, equipment, clothing, and vehicles and ensures that all equipment and supplies required for decontamination of the area are available. The area is constructed following either a maximum or minimum decontamination protocol or a nine-step procedure. The determination of which protocol is most appropriate is made in consultation with BEE. The decontamination officer establishes an area of control by setting up an entry and exit point along a straight line nearest the hot zone and ensures that: all decontamination sector personnel are following proper procedures, all personnel leaving the hot zone are properly cleaned, all personnel departing the decontamination area receive a medical sector evaluation, and equipment and supplies are confined and isolated for further evaluation. Incidents requiring chemical degradation must follow the appropriate mixing guides, while the decontamination officer supervises the mixing and the application of the degradation chemicals. Medical personnel are to establish a medical sector to monitor the personnel who work in the hot and warm zones. Baseline medical data are taken on all personnel before they don chemical protective clothing, and their vital signs are taken again when the clothing is removed after the decontamination process. Medical personnel compare these data and decide if the person is capable of continuing. If the

HQ 1776 ABW (MAC)
Andrews AFB, MD 20331-5000
15 Dec 86

INCIDENT EXPOSURE RECORD

IMPORTANT: Maximum working times for entry teams shall be determined by weather conditions and type breathing apparatus selected, as follows:

30 min SCBA - 15 min
1 hour SCBA - 30 min

NAME				
TYPE OF SUIT				
TYPE AIR SUPPLY				
TIME ON AIR				
ESTIMATED TIME OUT				
TIME INTO HOT ZONE				
TIME OUT HOT ZONE				
TIME OFF AIR				
TOTAL TIME IN SUIT				

Figure 12. Incident Exposure Record.

person cannot continue, this information is relayed to the decontamination officer for appropriate action.

The resource sector is responsible for the control and documentation of tools and equipment used during HAZMAT emergencies. The team leader and the resource sector officer determine the type of operation to be conducted and the equipment needed. With other base agencies, the resource sector obtains the necessary tools and equipment to be located in the warm zone, at or near the entry point into the hot zone. The resource sector is responsible for: ensuring that any equipment used before the arrival of the HAZMAT incident response team and during the emergency is appropriately handled; monitoring and replacing or resupplying expendable items; and identifying the contaminated items, which remain within the hot zone.

(2) Spill committee. At Andrews AFB the EPC deals with HAZMAT spills. That base's installation OSHA Council also addresses spill prevention. Each group meets quarterly.

(3) DPO plan. Andrews AFB has a DPO plan but we were informed that response to HAZMAT spills is not covered within it.

b. Edwards AFB

(1) SPR plan. Edwards AFB has a proposed hazardous substances spill contingency plan. The plan provides procedures for response and outlines required actions when hazardous substance spills/releases present threat to human health or the environment and/or when the magnitude of the incident exceeds the HAZMAT user's control, containment, stabilization, and/or cleanup capability as determined by the SFO. It also addresses the duties and responsibilities of base agencies and individuals responding to the spill. When a spill situation requires the implementation of the contingency plan, response is governed by human safety and protection of property and the environment.

The Edwards AFB HAZMAT response force consists of three tiers. Tier I is comprised of the initial responders, including the SFO (the ranking fire department representative on scene); the fire department HAZMAT response team; and security police, hospital, and environmental management personnel. The SFO responsibilities are to:

- (1) respond to the spill incident;
- (2) ensure, in conjunction with the security police, that the immediate, contaminated area has been cleared of all personnel;
- (3) as necessary, determine the extent of Tier I implementation;
- (4) direct the FCC to notify the command post if Tier II response is required;

(5) function as the OSC until the arrival of the Base Commander or his/her designated representative in the event Tier II is implemented;

(6) implement fire and explosion abatement action;

(7) designate the entry control point and relay the coordinates to the FCC;

(8) authorize the distribution of HAZMAT equipment from the HAZMAT response vehicle;

(9) make initial determination if the quantity of material spilled meets or exceeds the statutory reportable quantity for that material;

(10) if an EM representative is unavailable, make an initial report to appropriate regulatory agencies;

(11) provide a report detailing abatement procedures for any response operation in which an EM representative was not required to be present;

(12) provide technical assistance to the OSC, as needed, during tier II operations;

(13) participate in the incident review process.

The fire department HAZMAT response force chief is to:

(1) respond as directed by the SFO to the location of the incident;

(2) assess the hazards involved by positively identifying the materials, determining the quantity released, identifying the specific hazards as listed in the chemical's MSDS, and determining the possible locations and predicted ground tracks of hazardous atmospheres;

(3) recommend to the SFO any actions necessary to monitor, control, and contain the spill; supervise the fire department HAZMAT response force in control, containment, and small scale cleanup operations;

(4) advise the SFO/OSC when the safety of personnel is in question;

(5) supervise the fire department HAZMAT response force in emergency decontamination of affected personnel before their removal for medical treatment.

Tier II response is oriented toward cleanup. The structure of the group consists of the OSC, mobile command post, decontamination officer, industrial hygienist, environmental assessment, CE, and public affairs. The fire department's mission during Tier II operations is to provide support. Tier III response is also directed toward cleanup but is conducted by contractor personnel.

(2) Spill committee. Edwards AFB has a HAZMATs committee that is a subcommittee of the EPC. It meets monthly and is chaired by the chief of environmental planning, management, and compliance. The HAZMATs committee also consists of representatives from the fire department, safety, CE, judge advocate's office, comptroller, host-tenant liaison coordinator, maintenance, test group, disaster preparedness, logistics, hospital, and DRMO. The role of the subcommittee is to ensure that HAZMAT issues are reviewed, controlled, coordinated, and documented in compliance with AF regulations and base regulations and policies. The HAZMAT issues include, but are not limited to, acquiring, storing, using, recycling, substituting, and disposing of materials that were determined to be hazardous. HAZMAT issues requiring research, formulation of alternative strategies and proposed Edwards AFB policies, and preparation of proposed base supplemental regulations and operating instructions are accomplished by standing groups and special working groups.

(3) DPO plan. At Edwards AFB the DPO plan is implemented in the event of accidents/incidents involving radioactive or toxic materials, nuclear attack, aircraft and/or missile mishaps, mass casualties, natural disasters, and training exercises, or any other serious situation that affects the continued operation of the AFB. The Base Commander implements the plan as emergency/disaster conditions dictate.

Annex A of the Edwards AFB DPO Plan 355-1 deals with operations for major peacetime accidents. Major accident response is divided into three phases: notification/response, withdrawal, and recovery. During the notification/response phase, the primary and secondary crash nets relay to the various agencies all known and unclassified information relative to the emergency/disaster. The primary crash net alerts the following agencies: fire alarm center, hospital emergency room/hospital commander, flight surgeon, local area rescue, base operations, test center operations, and the Base Commander. Agencies receiving notice of an emergency or disaster over the secondary crash network must contact the fire department. The fire department contacts the command post, who contacts the OSC to determine the responsible agencies to be notified for response. Persons initiating either primary or secondary crash nets must decide whether or not to assemble the DRG. Responses to the disaster are made by an initial response force element and a follow-on force, as necessary. The initial force deploys directly to the accident/incident area and consists of elements (i.e., firefighting, medical, and security) necessary to assume control of the situation, to make objective evaluations, and to perform life-saving, suppression, and containment actions. The follow-on force is comprised of support teams whose specialties are needed after initial

evaluation. The follow-on force could consist of the OSC, disaster preparedness, BEE, security police, public affairs, CE, maintenance, explosive ordnance, staff judge advocate, chaplain, mortuary, safety, transportation, airfield management chief, tenant unit (as required), and photographer. When people are in imminent danger, a withdrawal order is issued by authority of the fire chief. The tasks of the fire chief during major accidents include the following.

- Assume control of the initial response force at the scene until the arrival of the OSC.
- Confirm the crash grid coordinates and transmit them to the command post.
- Coordinate with the security police and establish an entry control point; transmit the coordinates of the entry point to the command post.
- Conduct fire department activities in accordance with appropriate directives and checklists.
- Establish and operate a FCC in accordance with checklists.

Appendix 1 to Annex A of Plan 355-1 deals with the disaster response force. The purpose of the force in response to disasters is to command, control, and contain any situation so that the loss of life and property is minimized and mission capability is maintained. The disaster response force is organized into teams of specialists who are activated anytime base resources are required to suppress or contain emergencies or disaster conditions. The major elements that make up the force are the on-scene DRG, specialized disaster preparedness teams, control centers, and the command post. One of the specialized teams is the fire department decontamination team, with a minimum of eight people assigned, is responsible for decontaminating roads, areas, grounds, buildings, and facilities.

Tab A, Appendix 2 to Annex B of Plan 355-1 covers fire protection. This section states that the fire protection branch must be prepared to cope with the following types of potential disaster situations: incidents involving HAZMATs, natural disasters, attack, major accidents, major fire incidents, and incidents involving nuclear or conventional weapons. The fire department has three objectives when responding to a disaster. They are to: save lives and property, recover resources, and increase the salvage value of military resources involved in major accidents. In all disaster response situations that involve fire/crash-rescue operations, the senior on-scene firefighter assumes control of all on-scene forces until the designated OSC arrives. Upon arrival of the designated OSC, the senior firefighter briefs the OSC.

The senior firefighter then becomes the fire department representative of the on-scene DRG. He retains control of all firefighting and rescue operations until the threat of life and property has been adequately controlled. The operations section of the fire department responds under the direction of the senior on-scene firefighter with sufficient personnel and equipment to the affected area. The operations section also implements the necessary actions in accordance with directions from the senior on-scene firefighter and appropriate guidance to restore the situation to normal.

The FCC operator dispatches equipment and personnel to the affected area; notifies the security police, BCE, hospital, disaster preparedness, and water pump station operations; and relays emergency information to all units involved.

c. Hanscom AFB

(1) SPR plan. Hanscom AFB has a draft SPR plan that contains the required responses to releases, accidents, and spills of HAZMATs. It includes spill detection, reporting, containment, cleanup, and disposal procedures. The plan states that as soon as a discharge is discovered or suspected, it should be reported to the fire department. The information to be conveyed should include an estimate of the magnitude, nature, and location of the discharge. The fire department contacts the installation commander, BCE, security police, clinic, and command post.

The draft plan makes the installation commander the OSC, with responsibility for directing and coordinating all spill response actions. The commander has the authority to utilize the expertise and resources of the SRT in determining and performing response actions. The installation commander uses proper judgment to decide the nature of the response needed and contacts all or part of the SRT based on the type, quantity, and location of the spill. The deployment of the SRT is effected to provide a coordinated response to contain, control, recover all spills, and to restore the environment. SRT members include the: fire chief, BCE, BEE, disaster preparedness officer, chief of security police, liquid fuels maintenance foreman, staff judge advocate, public affairs officer, safety officer, clinic commander, transportation officer, and chief of operations.

The responsibilities of the fire chief are to: act as the OSC until the Base Commander or his designated representative arrives at the spill scene; immediately respond to HAZMAT spills as necessary to protect life and property with due regard for the environment; activate the DPO plan as necessary; dispatch an emergency operator to notify the base clinic if injuries are reported; provide technical assistance to the OSC concerning response to and handling of combustible, flammable, or hazardous substances; maintain protective clothing and equipment for response personnel within the fire department; and respond to HAZMAT incidents.

Appendix X of the draft SPR plan presents Hanscom AFB fire department's HAZMAT incident command system. It is exactly the same as that of Tinker AFB, which is presented in Section F.2d.

(2) Spill committee. The Hanscom fire department formed a base-wide HAZMAT committee in February 1986, as a subcommittee to the Base Commander's Consolidated Safety and Health Council. The HAZMAT Committee meets monthly and provides a quarterly status update to the council. The fire chief chairs the HAZMAT Committee, which includes representation from safety, disaster preparedness, security police, clinic (BEE and acute care), environmental engineering, meteorology, Lincoln Laboratory, AF Geophysics Laboratory (AFGL), RADCL, Base Supply, command post, and transportation.

(3) DPO plan. Hanscom AFB has a DPO plan, but according to the fire chief, proper response to HAZMAT spills is not included.

d. Tinker AFB

(1) SPR plan. Tinker AFB's SPR plan is implemented whenever a spill occurs. The response to a HAZMAT spill follows a four-phase program. Phase I identifies the initial spill response procedures to be followed by any individual discovering a spill or potential spill. It also designates the procedures to be followed by the fire department and CE in providing rapid notification of the spill to the proper on-base personnel and organizations. Phase II describes the general response actions to be taken by the OSC in the containing, cleanup, and restoration of the spill site. Phase III pertains to recovery of damages and enforcement; Phase IV details the ongoing training program.

Phase I covers actions taken to discover, locate, characterize, and report the spill. Any person recognizing a HAZMAT spill will immediately: activate the emergency alarm system; evacuate the area, if warranted by the type of spill; make sure that all employees shut down their operations and secure their equipment; inform the fire department of the type, location, and size or quantity of the spill, and name of the informant; inform their supervisor; contain the spill, if it can be done safely; perform cleanup operations within the unit's capabilities and assist the fire department upon its arrival; and ensure that an employee roll call is conducted to discover whether any personnel are trapped in the affected area. The fire department will notify the Tinker base consolidated command post, BCE, CE service call branch, base operations (if the spill is within airfield confines), security police, and if necessary, the hospital/emergency room. The BCE will notify the chief of the operations branch, water and waste unit, EM, safety office, BEE, and the BCE squadron duty officer.

The OSC is responsible for directing and coordinating all spill response actions during Phase II. He must deploy and utilize the expertise and resources of the SRT. The personnel assigned to the SRT include the chief of the fire protection branch, BCE, the Operations

branch, EM, directorate of maintenance, directorate of distribution, security police squadron, hospital, personnel division, office of public affairs, directorate of contracting and manufacturing, weather squadron, and safety office.

The fire chief, when notified of a spill or of a condition indicating that a spill is imminent, acts as the OSC until the BCE relieves him; notifies the consolidated command post, CE, operations branch, base operations, security police, and hospital/ambulance service; takes actions necessary to minimize or eliminate the potential for a spill; sandbag storm drains near wherever a spill occurs; if an aircraft jettisons fuel, goes to the scene and acts to control the fire or the potential fire; secures the area and keeps unauthorized personnel from entering until the security police arrive; and if poisonous gas is released, sounds two short blasts on an alarm to indicate its presence.

(2) Spill committee. The Tinker AFB Spill Committee is a subcommittee of the EPC. It is a standing committee with representatives from the following organizations: fire department, CE, EMD, directorate of supply, base fuels management, and the directorate of maintenance. The Spill Committee meets monthly. On a quarterly basis, the committee briefs the commanding general. It is responsible for annual review and update of the SPR plan. The reviews are conducted utilizing the same procedures as those used in the initial plan development. The review includes detailed inspection of oil and hazardous substance sites and verification of all data generated during the initial plan development. The Spill Committee submits a report to the EPC describing any deficiencies and recommended corrective actions.

Tinker AFB also has three other committees/working groups that address the handling or disposing of HAZMATs. They include: the Waste Water Working Group that meets monthly, the Technical Review Committee that deals with the installation restoration program and holds meetings quarterly, and the Technical Review Committee Working Group that meets monthly.

(3) DPO plan. Tinker AFB's DPO plan is implemented when the spill is declared a major accident. Annex M of the Plan 355-1 outlines the fire department's role during disaster situations. The CE commander is designated as the base fire marshall and is responsible to the Base Commander for overall administration of fire prevention, fire protection, firefighting, and aerospace rescue activities. The fire chief is directly responsible to the BCE for administrative management and operation of the fire protection branch. Duties of the fire chief include:

- Providing an on-scene representative from the fire protection branch for the disaster response force to supervise all fire prevention and firefighting activities.

- Providing personnel and equipment as required for disasters or exercises.

- Accomplishing required radio and telephone notifications.

- Plotting disaster/accident location on a grid map.

- Ensuring positive physical firefighting or fire prevention capabilities if priority resources are involved.

- Maintaining liaison and coordinating with civil firefighting agencies and requesting their assistance as required.

The firefighting vehicles responding to the incident are

- Inside a 5-mile limit: Rescue 1, Crash Truck 4, Crash Truck 3, Water Tanker 1, and Ramp Truck 2.

- Inside a 5- to 15-mile limit: Rescue 1, Crash Truck 4, Water Tanker 1, and Ramp Truck 2.

- Outside a 15-mile limit: under the direction of the assistant fire chief, equipment that will respond (at the discretion of the assistant fire chief) will assemble at the east side of Building 230 and convoy to the site.

(4) Other. The Tinker AFB fire department has developed a guide to aid in responding to HAZMATs incidents. The guide has five sections: HAZMAT/chemical incidents, HAZMAT incident command system, standard operating procedures for the HAZMAT response team leader, selection and donning of protective clothing, and standard operating instruction for decontamination procedures.

The HAZMAT/chemical incidents section covers alarm room and operation procedures. Upon receipt of a HAZMATs incident alarm, the alarm room personnel record the building number, post or bay number, location of the incident, and type of material involved and request the caller to direct and aid the firefighters. The dispatcher sounds the alarm in the fire house; notifies the SFO on duty; and dispatches the HAZMATs incident response team [Squad 1, an engine company, and the HAZMATs incident response van (HIT 1)], Chief 2, and a ramp vehicle to set up staging. The dispatcher also notifies the police, BCE, water and waste, BEE, the fire marshal, command post, EM, and base operations.

Upon notification of the HAZMATs incident, the SFO deploys and directs firefighters and equipment as needed, and implements the HAZMATs incident command system as required. Upon arrival at the scene, a cordon is established, depending on the type and severity of the chemical involved, and a decontamination area is set up near the access point to the hot zone.

The HAZMATs incident response team establishes itself outside the hot zone with vehicles facing a direction of escape. The

entry and backup teams suit up in the proper protective clothing as dictated by the situation. The decontamination team suits up in a level of protection no more than one level below the entry team's protective clothing. The entry team enters the hot zone (the maximum amount of time allowed in the hot zone is 14 minutes), sizes up the situation, and relays the information through the HAZMATs officer to the senior firefighter on scene. The entry team also rescues personnel as the situation dictates. Decontamination is accomplished before personnel or equipment leave the accident site. The SFO terminates the fire department's function when the incident is downgraded from an emergency status and turns the incident over to the appropriate agency for further action. Once the situation has been stabilized and rescue is complete, neutralization and cleanup are handled by the base's industrial waste unit.

The HAZMATs incident command system at Tinker consists of six major components: command staff, incident commander, operation section, staging, communications, and incident support (Figure 13). The command staff is headed by the Base Commander, who is responsible for the base's disaster response force. (In emergencies the entire force or portions thereof may be used as dictated by the requirements of the situation.) All base agency representatives report to the command post established by the Incident Commander to provide technical support for the command staff. In a HAZMAT accident the fire department is primarily responsible for establishing command, gaining control/stabilizing (e.g., diking, patching, plugging, evacuation, rescue), and notifying other agencies. The fire chief is the incident commander for action on all HAZMAT accidents. The fire chief's duties also include:

- (1) establishing command and setting up the command post,
- (2) evaluating the situation and determining the level of response,
- (3) keeping the command staff informed of all activities,
- (4) activating appropriate elements of the incident command system, coordinating all activities,
- (5) authorizing release of information to the news media in the absence of base public affairs,
- (6) maintaining records of the incident, and
- (7) monitoring the situation.

The assistant chief is responsible for management of the entire incident. Duties of the assistant chief include:

- (1) briefing and directing operation personnel;

HAZARDOUS MATERIAL INCIDENT COMMAND SYSTEM (TINKER AFB FIRE DEPARTMENT)

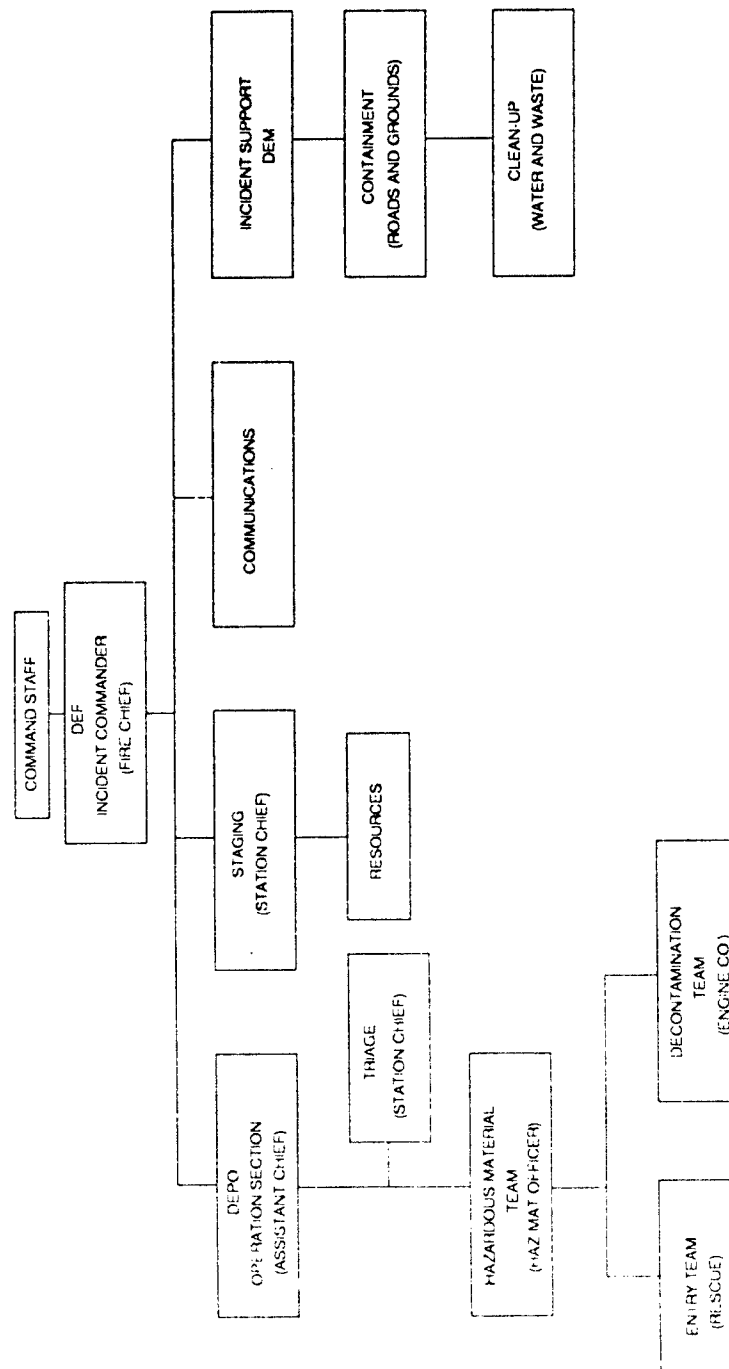


Figure 13. Tinker AFB HAZMAT Incident Command System.

- (2) supervising operations;
- (3) determining the need for and requesting additional resources;
- (4) reporting information about special activities, events, and occurrences;
- (5) determining and maintaining control zones.

The triage officer is responsible for the medical unit and medical care; keeping the operation chief informed of the status of casualties; maintaining liaison with base health officials, toxicology center physicians, and emergency medical personnel; and providing medical precautions to personnel involved in the incident.

The HAZMATs response team consists of entry and decontamination teams and is headed by the HAZMATs officer, who is responsible for the team's actions. The officer's duties are to act as the safety officer and monitor all actions to see that they are done in a safe manner, to keep the operation chief informed of all actions taken, and to supervise the entry team.

The entry team consists of two groups. Group 1 enters the hot zone where it is responsible for product identification and size-up, suggestions on containment of the hazard, and rescue as required. Group 2 is a backup group that is prepared to rescue, assist, and relieve Group 1. The decontamination team consists of an engine company and is headed by the officer of the company. The officer is responsible for setting up the decontamination area in the warm zone. The officer's duties include organizing and supervising the decontamination area; coordinating with the safety officer, health department, and other experts at the scene to select appropriate decontamination procedures; ensuring that all personnel and equipment leaving the decontamination area are properly decontaminated; determining the degree of protective equipment to be worn by personnel; and properly containing and labeling waste solution, clothing, and equipment for disposal. The staging officer is responsible for establishing a staging area in the cold zone out of any possible contamination, maintaining a list of available equipment and personnel, restricting access to the accident site, and establishing an access route to and from the staging area.

The response to a HAZMAT incident begins in the FCC. Once notified of a chemical spill, the FCC dispatches emergency equipment and becomes the heart of operation. Its main function is to monitor and relay vital information to the incident commander and to the firefighters on the scene. The FCC is also responsible for maintaining maps that indicate the accident site, perimeter of the accident site, and evacuation areas and for recording accurately all information relevant to the emergency.

The CE operations chief is the supervisor of the incident support group and reports to the Incident Commander. The incident support group's primary duties are containment, cleanup, and restoration. During containment, the group is responsible for activities such as diking of creeks and building of containment ponds; they are responsible for neutralization of the hazard during cleanup and for cleanup of the site. The cleanup team responds with a vacuum truck and two operators, a chemist, and a supervisor.

The standard operating procedures for the HAZMAT response team leader details the leader's functions. They include the following.

- Make sure that HIT 1 is positioned in the warm zone in a location where the overall accident site can be observed.
- Restrict entry into the hot zone to HAZMATs trained personnel and individuals possessing particular knowledge of the problem/incident.
- Follow and complete the HAZMAT incident checklist (Figure 14) and worksheet (Figure 15).
- Remain in contact with the SFO on the scene, the entry team, and the decontamination team.
- Retain authority to halt operations and to order personnel to clear the area if an unsafe condition is observed.
- Assign an individual to assist the leader if the incident warrants.

The selection and donning of protective clothing section of the guide describes three levels of protective clothing (fire-fighter bunkers, nonencapsulated protective clothing, and encapsulated suits) and their selection process. The determination of the level of protective clothing is based on the hazards and risks associated with the chemical involved and the availability of the clothing. This section of the guide also presents a procedures checklist for the donning of protective clothing.

The standard operating instruction for decontamination procedures identifies the decontamination officer's functions and exhibits a decontamination procedure checklist. The functions of the decontamination officer are to: assume the responsibility for establishing an area for removal of harmful substances from emergency response personnel, victims, equipment, clothing, and vehicles, and, in conjunction with the HAZMATs response team leader, for determining where the decontamination area will be, what level of protection is required for the decontamination team, and the decontamination required.

HAZARDOUS MATERIAL INCIDENT CHECKLIST

1. NATURE OF INCIDENT: _____

2. LOCATION: _____

3. DATE AND TIME: _____
4. SENIOR FIREFIGHTER ON THE SCENE: _____
5. HMRT LEADER: _____
6. DECONTAMINATION OFFICER: _____
7. TEAM PERSONNEL: _____

YES NO

- A. IS THE AREA ISOLATED AND ENTRY DENIED?
- B. DOES THE INCIDENT NECESSITATE ACTIVATION OF THE
POLLUTION SPILL LOG?
- C. ACTIVATE THE HAZARDOUS MATERIAL INCIDENT COMMAND
SYSTEM
- D. IDENTIFY HAZARDOUS MATERIAL(S) INVOLVED
RESEARCH HAZARDS ASSOCIATED WITH CHEMICALS.
(USE THE WORKSHEET)
- E. ARE WE EQUIPPED TO HANDLE THE SITUATION?
- F. IS A DECONTAMINATION AREA NEEDED?
- IF YES, HAVE THE DECON AREA SET PRIOR TO ACCESS
INTO THE HOT ZONE BY THE ENTRY TEAM
- G. ARE THE ENTRY TEAM AND BACKUP READY?
- H. BRIEF THE ENTRY TEAMS OF THEIR ASSIGNMENTS
- I. BACKUP TEAM READY FOR EMERGENCIES

Figure 14. Hazardous Material Incident Checklist.

YES NO

- J. MONITOR RADIO COMMUNICATIONS
- K. DECONTAMINATE ENTRY TEAM IF APPLICABLE
- L. DEBRIEF ENTRY TEAM
- M. RELAY INFORMATION TO ON-SCENE COMMANDER
- N. DISCUSS TACTICAL OPTIONS
- O. BRIEF ALL TEAM MEMBERS OF ALL RESPONSIBILITIES AND
ACTIONS TO BE TAKEN
- P. IMPLEMENT TACTICAL DECISION
- Q. REEVALUATE THE SITUATION
- R. DECONTAMINATE PERSONNEL AND EQUIPMENT
- S. TERMINATE THE FIRE DEPARTMENT ROLE. FIRE DEPARTMENT
BECOMES A SUPPORT AGENCY
- T. COLLECT ALL INFORMATION, DEBRIEF PERSONNEL
- V. ENSURE ALL PERSONNEL ARE AWARE OF THE POSSIBLE
SIGNS AND SYMPTOMS OF EXPOSURE TO THE HAZARDOUS
SUBSTANCES(S)
- U. WRITE REPORTS IN ACCORDANCE WITH LOCAL AND
AIR FORCE DIRECTIVES

Figure 14. Hazardous Material Incident Checklist (Concluded).

HAZARDOUS MATERIAL WORKSHEET

CHEMICAL(S) INVOLVED: _____

PHYSICAL CHARACTERISTICS _____

UN NUMBER: _____ **CLASSIFICATION:** _____

HEALTH HAZARDS: _____

TREATMENT: _____

FIRE HAZARDS: _____

EXTINGUISHING AGENTS: _____

REACTIVITY HAZARDS: _____

SPECIAL HAZARDS: _____

PROTECTIVE CLOTHING REQUIRED: _____

DECONTAMINATION PROCEDURES: _____

REMARKS: _____

Figure 15. Hazardous Material Worksheet.

3. Interface during HAZMAT emergencies

This section has been developed from information obtained during site visits to fire departments.

a. Andrews AFB fire department

At Andrews AFB response to a major HAZMATs incident involves 14 to 20 people, including personnel from the fire department and the BEE (an information resource for help in characterizing the hazard). Medical people are needed for monitoring the personnel. People are also required for relaying information (1 to 2 people), safety (1 to 2), reconnaissance (2), and backup (2), decontamination (4), resources (2 to 3), and a team leader. If a computer is used as an aid (information resource), the size of the team could be reduced. Figure 16 diagrams the Andrews HAZMAT emergency response team. The fire chief is in charge until the Base Commander implements the disaster response plan. The Base Commander is then the OSC. The SFO is still in charge of the technical decisions in regard to firefighting. (The fire chief can evacuate personnel from within the emergency zone, while the Base Commander controls personnel outside of the immediate zone. The Base Commander cannot order fire personnel back into a hot zone.)

b. Edwards AFB fire department

The fire chief proposed that a three-tier response structure be used to deal with HAZMATs incidents (Figure 17). During Tier 1, the fire department would have primary responsibility; the HAZMATs incident response van, along with the engine company closest to the incident, a first-aid vehicle, and the chief's and deputy chief's cars would respond. The fire department would decide on the level of an incident and act accordingly. Others who would be part of tier one include: BEE, hospital personnel, and security police. Tiers 2 and 3 would be oriented toward incident site cleanup and be under the control of the Base Commander. In Tier 2, Edwards AFB personnel would be the responsible party; ~2 to 12 people (e.g., machine operators, industrial hygiene, environmental management, supply, and the BEE) may become involved. Tier 3 cleanup would be the responsibility of the contractor staff.

c. Hanscom AFB fire department

The fire chief stated that Hanscom AFB HAZMAT incident response concept consists of two parts. The first is directed by the fire chief and is comprised of preliminary assessment, additional support requests, firefighting, evacuation of personnel, and access control. The second part is directed by the OSC and consists of laboratory representatives taking part in the assessment and control of the incident. The laboratory representatives are identified via a list of contacts (name and phone number) that is posted on the door of each room in the laboratory. Others who might be involved in the second stage include: clinic (ambulance and BEE), disaster preparedness, and BCE.

ANDREWS AIR FORCE BASE
HAZMAT EMERGENCY RESPONSE TEAM

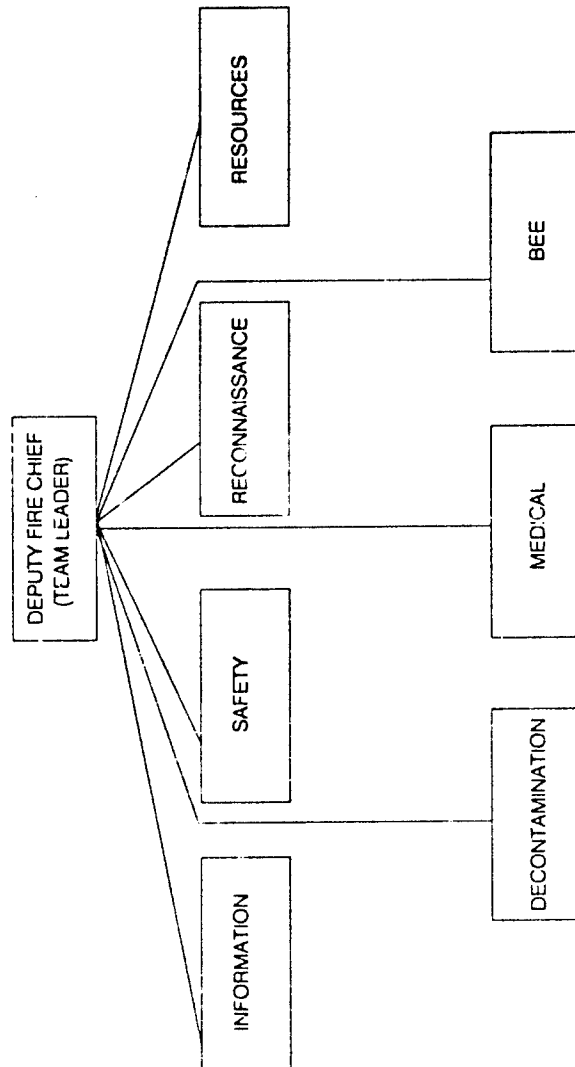


Figure 16. Andrews AFB HAZMAT Emergency Response Team.

EDWARDS AIR FORCE BASE HAZMAT EMERGENCY RESPONSE TEAM

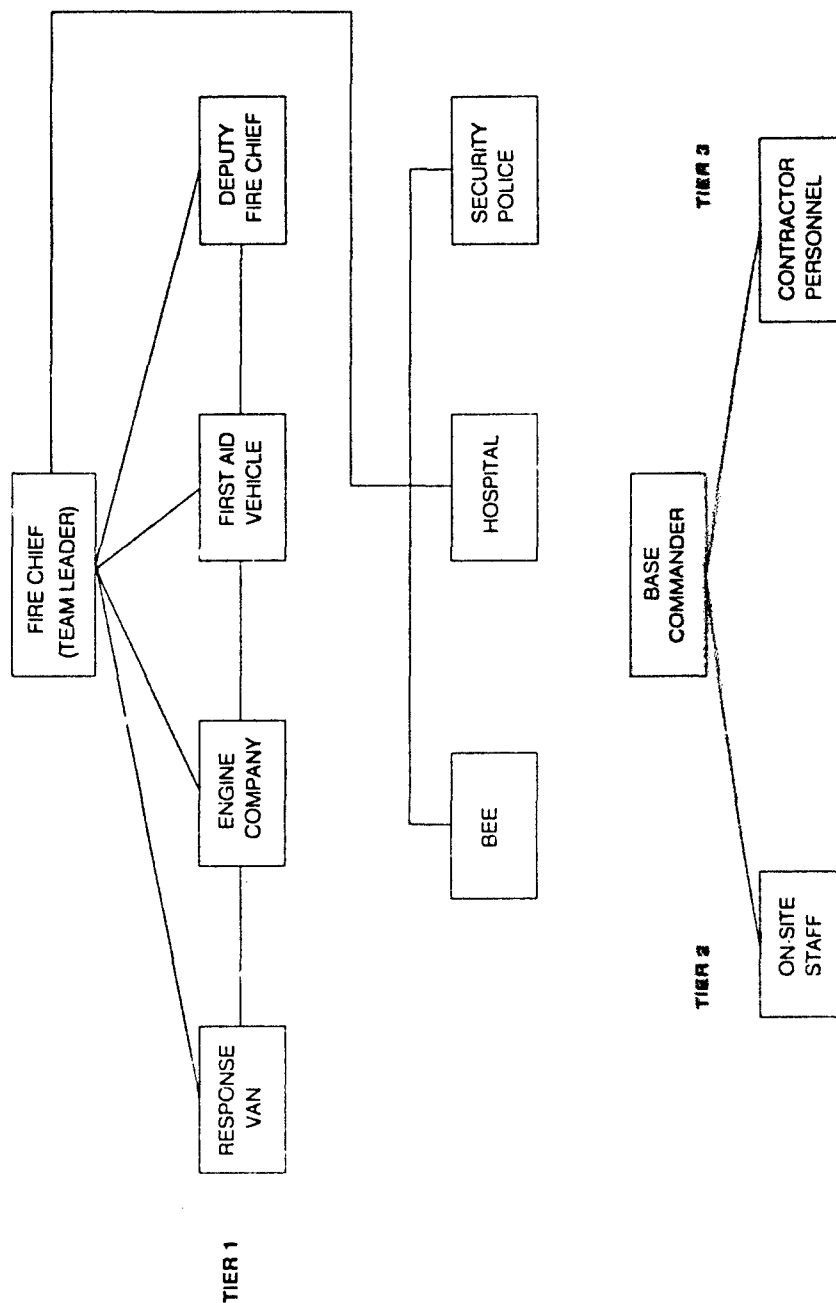


Figure 17. Edwards AFB HAZMAT Emergency Response Team.

The second stage of the response is only implemented if the fire chief determines that the HAZMATs spill is a major incident and informs the Base Commander. The OSC is Base Commander and the fire chief is his technical advisor or the fire chief (if the commander decides that the chief can handle the situation). If the Base Commander becomes the OSC, then the fire chief becomes a technical advisor. At Hanscom at least 15 people are needed to respond to a full-scale HAZMAT emergency. Two people will be required to wear protective clothing, two people for backup, plus two each for help in donning, doffing, and decontamination. The fire department responds to a HAZMATs incident with two pumpers, a command/control vehicle, the fire chief's truck, the deputy fire chief's van, and one rescue vehicle. The fire department immediately notifies security, BEE, and the safety department (for the facility where the incident is). Other people are contacted, depending on what type of chemical is involved. Figure 18 shows Hanscom's two-part HAZMAT emergency response concept.

d. Tinker AFB fire department

When a spill occurs, the individual who finds the spill at Tinker AFB calls the fire department, CE, safety, and the BEE. The fire department responds immediately. As a HAZMAT leader goes to the scene of the incident in his van, he is accompanied by Squad 1 and an engine company from the closest firehouse. The HAZMAT leader may call upon other agencies, as needed. The entire disaster response team is called upon only about one-fourth of the time. Once the incident is under control, the job is turned over to the Water and Waste Departments. In some cases, a contractor might be brought in to cleanup.

4. Other information obtained from visits to fire departments

a. Andrews AFB

The fire chief at Andrews AFB has identified the HAZMATs incident response team and a team leader. The HAZMATs team is just being formed. The HAZMAT team consists of four people from the fire department - two military and two civilian. Andrews AFB has recently obtained a dedicated HAZMAT incident response van but had not received the needed HAZMAT equipment and protective clothing. The following problems were identified in regard to emergency response: information, evacuation, decontamination, equipment, and safety. The HAZMAT leader believes that Andrews needs computers for both the preplanning and emergency response stages. There should be a personal computer at the coordination center, in the fire house alarm room, in the SFO's vehicle, and in the HAZMATs incident response van. With a personal computer, information could be on-hand to access readily in emergency situations. They would like to have a matrix of protective clothing by chemical. Biomedical monitoring of personnel should be done before and during a HAZMATs incident.

The HAZMAT leader sees a need for development of HAZMAT training, both specific (for specialized chemicals) and generic. He has

HANSCOM AIR FORCE BASE HAZMAT EMERGENCY RESPONSE TEAM

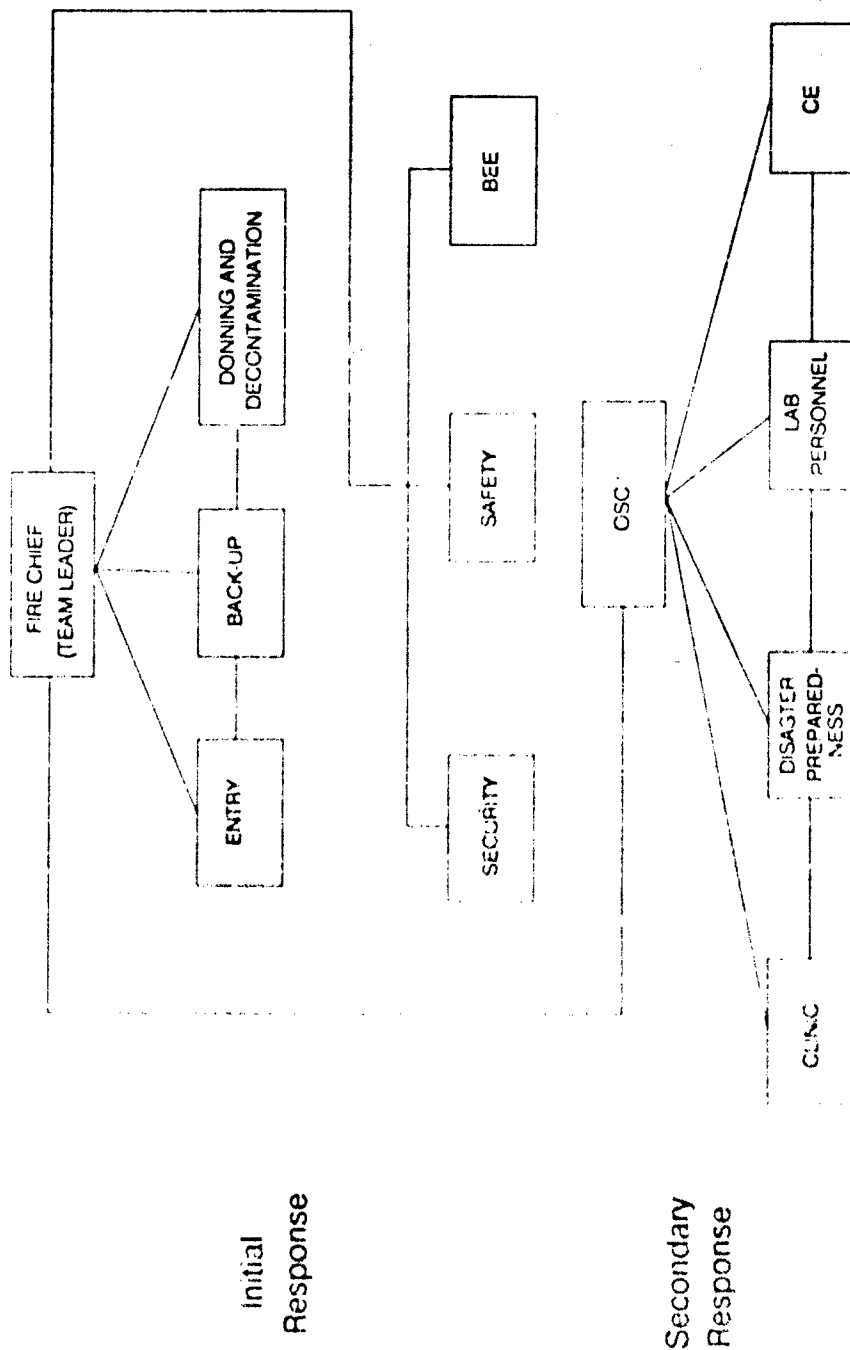


Figure 18. Hanscom AFB HAZMAT Emergency Response Team.

developed a number of relevant courses and trained both fire department personnel and people from CE, the hospital, and safety. He plans to develop training standards and other training courses. Andrews has a fire department mutual response aid agreement with Prince Georges County, Maryland. The HMIMS should contain information to support setting up a field operation and should have on location chemical names and container type, MSDSs, clothing, equipment needed, and a description of specific evacuation routes that could be available for implementation immediately upon discovery. It also may be valuable to have lists of chemical manufacturers and contacts for different chemicals. The fire department would like to have a well-developed computer inventory and a complete set of MSDSs. The HAZMAT leader would like to see the Eight-Step Process (Reference 5) used by the Prince Georges County HAZMAT team implemented AF-wide. At Andrews a primary chemical information resource is the manual version (microfiche) of the DOD HMIS.

The fire department also has copies of the following HAZMAT-related documents: the DOT Emergency Response Guidebook (Reference 2) the CHRIS Hazardous Chemical Data Manual (Reference 6) by the Coast Guard, the Pocket Guide to Chemical Hazards (Reference 7) by the National Institute of Occupational Safety and Health, the Emergency Handling of Hazardous Materials in Surface Transportation (Reference 8) by the American Association of Railroads, the Fire Protection Guide on Hazardous Materials (Reference 9) by the NFPA, the Acutely Toxic List by the EPA (Reference 10), and Sax's book entitled, Dangerous Properties of Industrial Materials (Reference 11).

b. Edwards AFB

The fire chief at Edwards AFB stated that the fire department should be concerned with initial response during a HAZMATs emergency. He feels that it is the fire department's responsibility to save lives and protect property. He is not sure what the term "stabilization" in the December 1985 AF letter* on fire protection HAZMATs incident involvement means. He said that the fire department will fight the fire first and then deal with the HAZMATs emergency. He believes that the HAZMATs team should be separate yet work with the firefighters. The fire chief would have a HAZMATs incident response team go in at the same time as the fire department, set up an incident control point, and assess the situation. He has not yet assigned an individual the responsibility of being the HAZMATs incident response team leader. He has, however, sent a member of the fire department's training group, to two courses on the CAMEO software. The fire chief stated that there is no official guidance or consolidated source of information currently available for HAZMATs incident response. He remarked that the primary resource used in the past was the DOT Emergency Response Guide (Reference 2). He briefed the commanding general at Edwards on CAMEO's

*See footnote in Section IIB.

capabilities. Approval was subsequently given to look seriously at it as a possible alternative for providing guidance on HAZMATs incident response. The fire chief believes that more manpower (probably a three-person team) will be needed to deal with the additional duty of responding to HAZMATs incidents. There are approximately 280 to 300 HAZMATs and about two gas leaks/spills per month at Edwards. The fire chief would like to know in what facilities HAZMATs are used and in what quantities they are stored.

The fire department at Edwards is in the process of procuring a HAZMAT incident response van. Protective clothing, tools, and stabilizing chemicals will be available for use and stored in the van. The fire department plans to have three computers for dedicated HAZMATs incident response use: one in the response van, one at the fire department's training facility, and one at a remote site (Space Mountain). Each computer will be tied into a portable weather station. At present, the only protective clothing that the fire department has is standard firefighting suits and none for responding to HAZMATs incidents. The fire department is in the process of procuring the needed clothing. The fire department has put together a number of HAZMATs emergency-related training courses. They cover such items as equipment, use of clothing, and how to deal with HAZMAT incidents. The fire department has already trained three personnel and has plans to instruct six others. The fire chief believes that HAZMATs emergency responders should be tested and certified. The Edwards fire department does not currently receive MSDSs, but this probably will change in the near future. The fire department is not kept informed of IRP work. They also do not know what is located in each of Edwards' 38 hazardous waste accumulation points. However, the fire department is alerted when explosives are being transported onto or through the base.

c. Hanscom AFB

Hanscom AFB is comprised primarily of laboratory facilities. The laboratories include: Lincoln Laboratory, the AFGL, and two divisions of RADC. The fire chief is also the HAZMATs emergency response team leader and the Office of Primary Responsibility for HAZMATs emergencies planning at the AF Systems Command's 15 bases. The fire chief provides HAZMATs emergencies information and guidance to the bases, but each base makes its own decisions. About 30 to 40 percent of the buildings at Hanscom have HAZMATs. There were 57 reportable HAZMATs incidents, including false alarms, natural gas leaks, etc., during the first three quarters of FY 1987. He believes that the fire department's main roles during HAZMATs incidents should be emergency response and stabilization. He believes that additional manpower is needed to deal with the new and extra responsibilities of HAZMATs. If additional personnel are not provided, then adequate (new) equipment should be provided to compensate the personnel deficiency. When classified materials in transit are involved in a HAZMAT incident, he plans to control the fire and then back off. A checklist is used to respond to a HAZMAT incident. The main items in the checklist include emergency information, objectives and tactics, considerations, and comments. The Hanscom

AFB fire department has mutual aid agreements with the towns of Bedford, Concord, Lexington, and Lincoln, Massachusetts.

Hanscom AFB prefire plans are being computerized. Figure 19 illustrates AF form 1028, Facility Pre-Fire Plans. The plans will have maps, zones of withdrawal, buildings to be evacuated, and entry and control points. The fire department will keep hard copies of the plans as emergency backup. The fire department does not currently have a dedicated HAZMATs incident response van. A joint HAZMATs/rescue truck is scheduled for procurement in fiscal year 1990. Equipment to be included in the HAZMATs truck includes cellular telephones and a portable computer. Computers will also be ordered for the response unit vehicle and for the deputy chief's car. The fire chief plans to procure most of the equipment from local purchase during fiscal year 1988. Chemical data manuals are currently stored in the back of the fire chief's car. The books include CHRIS manuals by the Coast Guard (Reference 6), Emergency Handling of Hazardous Materials in Surface Transportation (Reference 8), the Emergency Response Guidebook (Reference 2), the Fire Protection Guide on Hazardous Materials (Reference 9), and the Dangerous Properties of Industrial Materials (Reference 11). MSDSs are kept at the fire department, BCE, and the safety office.

The fire chief believes that firefighters should be certified in HAZMATs incident response. He stated that the HMIMS, which was developed by ORNL, should be adaptable for different bases; same information available but for different uses. He suggested that the HMIMS should include prefire plans, knowledge of location of the chemicals and identity of each, access to MSDSs, the radius of withdrawal for each chemical, incident response techniques, guidelines, and decontamination procedures. The fire chief stresses the importance of knowing who to contact rather than what chemicals are where.

The fire department provides in-house training on protective clothing, airpicks, donning of clothing, use of chlorine kits, and communication. Eventually training will be given to the entire response team. Presently, the fire chief and the training officer are the only fire department personnel who have received HAZMAT incident response training. The HAZMATs responders are provided with scenario walk-throughs, which are oriented toward defining responsibilities, procedures, and checklists. Individual researchers in the laboratory facilities are being trained to assist the HAZMATs response team in identifying problems in their laboratory and in stabilization strategies. The fire chief stated that a three-phase course offered in Florida and the course at the National Fire Academy (NFA) provide suitable HAZMATs response training. He believes that additional fire department personnel will be required by FY 1989 to support HAZMATs incident response training and the additional equipment.

d. Tinker AFB

The fire chief ultimately is responsible for response to HAZMATs emergencies at Tinker AFB. The training officer for the fire

FACILITY PREFIRE PLAN		1 FACILITY NO — —	2 OCCUPANCY — —
3 ADDRESS OR LOCATION		4 TYPE CONSTRUCTION	
5 WATER AVAILABLE AT 20 PSI		6 DRP FOR SPHLR	
7 WATER REQUIRED — GPM FOR — HOURS		8 OTHER WATER SOURCES	
9 UTILITY SHUTDOWN (METHOD OF OPERATION)		10 INSTALLED SYSTEMS	
ELECTRICITY		<input type="checkbox"/> WET PIPE SPHLR <input type="checkbox"/> DRY PIPE SPHLR <input type="checkbox"/> PRE ACTION <input type="checkbox"/> DELUGE SPHLR <input type="checkbox"/> HALON 1301 (LOCAL) <input type="checkbox"/> HALON 1301 (TOTAL FLI) <input type="checkbox"/> CO2 (LOCAL) <input type="checkbox"/> CO2 (TOTAL FLI) <input type="checkbox"/> STAND PIPES <input type="checkbox"/> OTHER (Specify)	
GAS			
11 EXPOSURES		12 SPECIAL FEATURES	
		<input type="checkbox"/> FIRE WALL <input type="checkbox"/> FIRE DOORS <input type="checkbox"/> ATTIC <input type="checkbox"/> BASEMENT <input type="checkbox"/> ROOF VENTILATORS <input type="checkbox"/> WINDOWLESS <input type="checkbox"/> ELEVATORS <input type="checkbox"/> COMPLEX INTERIOR ARRANGEMENT <input type="checkbox"/> OTHER (Specify)	
14 VENTILATION PROCEDURES		13 ALARM AND DETECTION	
		<input type="checkbox"/> LOCAL ALARM ONLY <input type="checkbox"/> SMOKE DET <input type="checkbox"/> HEAT DET <input type="checkbox"/> FLAME DET <input type="checkbox"/> AUTOMATIC TRANSMITTER <input type="checkbox"/> OTHER (Specify)	
ROOF VENTILATION <input type="checkbox"/> FEASIBLE <input type="checkbox"/> NOT FEASIBLE			
15 HAZARDS		16 FIRST ALARM EQUIPMENT	
<input type="checkbox"/> FACILITY CONTAINS EXPLOSIVES SPECIFIC INFO IN FIRE COM CENTER			
17 OTHER FACTORS COMMENTS			

AF FORM 1028 NOV 75 PREVIOUS EDITION IS OBSOLETE

Figure 19. AF Form 1028, Facility Prefire Plans.

SYMBOLS AND COLOR CODES		FORM COMPLETION INSTRUCTIONS
	<p> R - RED B - BLUE G - GREEN Y - YELLOW O - ORANGE </p> <p> Y (S) SMOKE DETECTOR Y (H) HEAT DETECTOR Y (F) FLAME DETECTOR R (HS) HALON FIRE SUPPRESSION SYSTEM R (CO₂) CO₂ FIRE SUPPRESSION SYSTEM R (DC) DRY CHEMICAL FIRE SUPPRESSION SYSTEM R (X) SPRINKLER RISER B (G) GAS SHUT OFF R (AS) AUTO SPRINKLING IN BLDG OR RM R (AS) PARTIAL SPRINKLING IN BLDG OR RM R (2 OF 3) FIRE HYDRANT - Number indicates outlets B (E) ELECTRICAL SHUT OFF R (AP) ANNUNCIATOR PANEL R (FAP) FIRE ALARM PANEL R (HC) STANDPIPE HOSE CABINET G (EL) ELEVATOR G (OH) OVERHEAD DOOR G (S) SLIDING DOOR R (FP) INSTALLED FIRE PUMP R (NS) BLDG OR RM NOT EQUIPPED WITH SPRINKLER SYSTEM 1/2" (10) FIRE DEPARTMENT CONNECTION FOR SPRINKLER SYSTEM 1/2" (10) FIRE DEPARTMENT CONNECTION FOR STANDPIPE SYSTEM — N NORTH INDICATION — P POST INDICATION VALVE — F FENCE EXPLOSIVE SYMBOLS 0 (1) (2) (3) (4) </p>	<p>BLOCKS 1, 2, 3, 6, 10, 12 and 13 are self explanatory</p> <p>BLOCK 4 - Type "N" or "C".</p> <p>BLOCK 5 - Water available from the base water distribution system</p> <p>BLOCK 7 - IAW AFM 88-10, Chapter 6</p> <p>BLOCK 8 - Lakes, ponds, rivers, swimming pools, etc.</p> <p>BLOCK 9 - Indicate the methods used to shut down the utilities</p> <p>BLOCK 11 - List the exposures you would expect should this facility become fully involved in fire</p> <p>BLOCK 14 - Plan ventilation procedures for a major fire. Particular attention must be given to attics and basements, and room construction</p> <p>BLOCK 15 - List any hazards in or immediately surrounding this facility that is not indicated on the facility sketch. Give further details of hazards indicated on the sketch if necessary</p> <p>BLOCK 16 - List first alarm vehicles and any special equipment not carried by first alarm vehicles which would be needed to control an interior fire</p> <p>BLOCK 17 - Indicate special fire or rescue problem e.g. handicapped occupants, elevator, elevator manual override procedures, elevator escape hatches and operation, special features of installed systems necessary for their effective operation man traps and other hazards to fire fighters, operating procedures for over doors or other nonstandard doors</p>

Figure 19. AF Form 1028, Facility Prefire Plans (Concluded).

department is also appointed as the HAZMATs incident response team leader. In 1984 there were 71 HAZMAT incidents at Tinker. During 1985 and 1986 the totals decreased. The fire chief attributes this decrease to the fact that a training program on how to deal with chemicals has been implemented base wide. Spills at Tinker vary in size with the average between 1 and 55 gallons, although some have been more than 10,000 gallons. The fire chief believes that the fire department has three main tasks to perform during HAZMATs incident response: suppression, rescue, and control. During an incident the leader is required to complete a HAZMAT worksheet and incident checklist. The fire department has generated six volumes of prefire plans for many of the facilities/buildings at Tinker. The fire chief would like to have these plans in a color graphics, computerized data base and to have a computerized spill database to list the number of spills that have occurred in a given building and the cause of the spills. He suggested that the HMIMS listing should include only the most hazardous chemicals, quantities that will "hurt the firefighters," and the protective clothing needed. He felt that the HMIMS should be a stand-alone system that is accessible to the OSC, the HAZMATs response team leader, and the responding fire truck.

Tinker AFB has contingency agreements with the fire department's in both Oklahoma City and Midwest City, Oklahoma. Tinker has called upon the two departments only once for assistance during a HAZMATs incident (needed more protective clothing than was on hand). Criteria that the fire department uses in defining the degree of incident include the type of chemical, the quantity, where the chemical is used and stored, and how many people are in the area. Problems and needs that the fire department has had during a HAZMAT emergency response include: improperly marked containers, the lack of MSDSs, where in each building HAZMATs are located, overlap of different materials with the same MSDS, and estimated quantities of each chemical. A system is needed for cross referencing materials and data on decontamination procedures. The fire department has a new HAZMAT truck referred to as HIT 1. The components currently stored inside of HIT 1 include: a library, protective clothing (butyl-rubber suits and gloves), and leak seal bags. The library has the following documents: Chemical Hazard Response Information System (CHRIS) manuals (Reference 6), DOD HMIS,* DOT Emergency Response Guidebook (Reference 2), Condensed Chemical Dictionary (Reference 12), HAZMAT truck referred to as Emergency Handling of Hazardous Materials in Surface Transportation (Reference 8), the NFPA Fire Protection Guide on Hazardous Materials, (Reference 9), and MSDSs service by Information Handling Services.

HIT 1 has ample room for other types of equipment. Plans call for the incorporation of layered maps. The fire department has sent 10 of its firefighters to a 2-week HAZMATs incident response

*See footnote in Section IIB4.

training course at Oklahoma State University. According to the HAZMAT leader, each of the AFLC bases has sent 10 people. Oklahoma State University has also taught a course at Tinker to 16 firefighters. The HAZMAT leader is preparing a training program for Tinker AFB that will be analogous to Oklahoma State University's two courses. Lesson plans will be generated and training is to begin shortly at Tinker's HAZMAT incident response training area. The HAZMAT leader recommended three levels of HAZMATs incident response certification.

G. INFORMATION ON HAZMAT-RELATED HARDWARE AND SOFTWARE

With no centralized specific guidance on how to respond to HAZMATs incidents, most fire chiefs see a need to consolidate sources of information. Directions taken have been reflective of individual initiative, coupled with resource potential (i.e., larger departments probably have a greater potential to obtain hardware and computing skills than do small departments). Larger departments are also more apt to have the ability (flexibility) to assign (or allow) a person to focus on hardware/software questions related to the perceived need of that department at a specific base.

In the survey, three bases had some idea of the types of hardware desired as well as a general concept of what they wanted software to do. These three bases were convinced that, to be effective, an HMIMS had to reside in a dedicated computer that could be portable (to provide on-scene assistance in the decision making process). The fourth base thought that the existing (time-sharing) Work Information Management System (WIMS) may be sufficient for the fire chief's needs; however, this department was exploring the potential value of the CAMEO software.

Three of the four fire chiefs believed that they could and would justify the choice of systems believed best suited to their needs. It was only a question of identifying the source of funds. One fire chief thought that the appropriate hardware/software should be more clearly spelled out by higher level management like many things in the AF, such as the Table of Allowance, levels of manpower. The following paragraphs describe the computer systems and software identified during the site visits.

1. Computer Hardware and Software at Air Force Bases

a. Andrews AFB

The WIMS System (using a Wang mainframe and dumb terminals) is used in the Andrews AF fire department. Also Zenith Z-100 PCs are used; recently, several commercial packages have undergone evaluation. These include the Emergency Information System (EIS) by Research Alternatives of Rockville, Maryland, and microCHIRIS and microOHM-TADS by First System of Great Neck, New York. EIS consists of a number of programs including hazard analysis, event log, resource inventory,

special emergency needs, shelter status, and automated emergency plan. MicroCHRIS and microOHM-TADS are data bases consisting of about 1000 and 1400 chemicals, respectively. The data consist of chemical, physical, and biological information. The software was designed based on the CHRIS and OHM-TADS manuals.

b. Tinker AFB

At Tinker, the WIMS was in use along with a VS65 in the fire department and a VS-100 at CE; however, the system is shut down whenever lightning is within 10 miles of the base. The system is also unavailable for 4 hours every night due to data backup procedures. Base Supply uses a mainframe IBM and a Sperry 1100-60. It was mentioned that of the 385 pieces of software provided by the AF, only two were found useful for fire chief's applications. Further, the WIMS, which is tied to the VS-100, was not designed for field support. Tinker, like Andrews has very definite ideas about what software should do, and they have developed a long-range (~5 year) plan for a system called GENESIS to be suitable for their needs. This software system appeared to be in the conceptual stage. Tinker is a very large base and, over the course of a few years, may have the resources to develop its own product. The GENESIS system is being designed to provide the OSC with timely information under the most adverse conditions. Through GENESIS, the user in the field will have access to information on HAZMATs and their locations, floor plans, water availability, population information, etc. Maximum use of existing software is planned. Extensive graphics capabilities are required.

c. Hanscom AFB

Although it has no flying mission, Hanscom is the headquarters for the Electronics System Division and contains mostly laboratory facilities. The fire department has a 20-megabyte Wang personal computer, Motorola MX-300, two 2-megabyte Zenith Z-248s in addition to the WIMS. The Wang personal computer is considered a good backup for the Z-248 but too slow for HAZMAT incidents.

RADC has a Laboratory Material Control Activity that belongs to Systems Command. One of its primary functions is to process and track HAZMATs. The Local On-Line Network (LONEX) connects all RADC computers with E-mail and ties into the base computer, which handles scientific computing and communications. According to the RADC safety officer, this LONEX probably cannot communicate with supply functions.

Lincoln Laboratories has a computerized HAZMAT inventory system that is linked with their supply/procurement computer. The inventory (updated monthly) includes a list of HAZMATs and the point of contact for each room where they may be located. Lincoln Laboratories has direct contact by radio with the fire chief.

The fire chief at Hanscom is exploring a variety of software items including PROFILE by Tandy Corporation for prefire plan

development and CHRISTY, microCHRIS, microOHM-TADS, and CHART (by Microsoft) for graphics. One advantage of the microCHRIS, an HAZMAT package, is that hard copy is available in the event of machine failure.

d. Edwards AFB

The fire chief at Edwards has the WIMS and finds it to be useful to the extent that a fire chief should rely upon a computer system. However, the Edwards fire chief has rented an Apple MacIntosh SE to explore CAMEO. In addition, the EM Division has Zenith Z-248 machines. These communicate with CYBER and Sperry mainframes on base. With the WIMS, the fire chief has computerized prefire plans with the exception of the graphics, which the WIMS is not capable of. (There are about 85 other fire department-related programs stored in the WIMS.) The fire chief is exploring the possibilities of the CAMEO system but would prefer that the AF provide some central direction regarding HAZMAT hardware/software. The newly created EM Division is to develop a system to track chemicals from ordering through disposal. It is not clear at this time how the fire chief would have access to that data.

2. Computer Hardware and Software in Selected Cities

Depending on the number and extent of historical events, metropolitan areas may or may not have hazardous response groups associated with the fire departments. Presently, some metropolitan areas have separate HAZMATs groups. This section will briefly describe the type of hardware/software used by two selected cities. Not all large cities have separate, identified HAZMAT initiatives.

a. Seattle, Washington

The Seattle fire department uses the CAMEO computer code, which was developed through a joint effort of Hazardous Materials Response Branch of the National Oceanic and Atmospheric Administration (NOAA) and the Seattle fire department (References 13 and 14). This HAZMATs computer system (Figure 20) is designed to operate with the Apple computer system and makes extensive use of MacIntosh software such as MacPoint and MacDraw. These tools are used to display information for major files, which can be used interactively:

(1) Air model. The air model can assist in the forecast of downwind chemical concentrations resulting from an accident. It incorporates information from either a portable atmospheric station or from input obtained from a local weather service. The system uses a dispersion model based on the EPA Workbook of Atmospheric Dispersion Estimates.

(2) Mapping. Sufficient data storage is provided to encompass detailed maps of the city, as well as floor plans and chemical inventories for hundreds of facilities. Any given map can be displayed on the computer screen or printed within a few seconds.

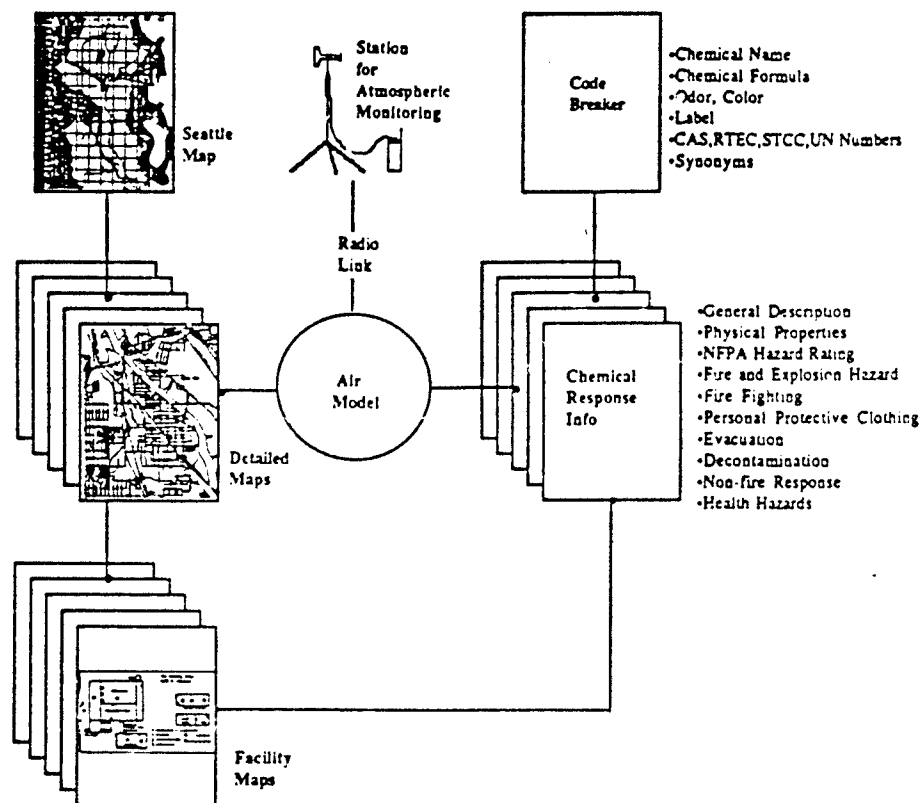


Figure 20. CAMEO Components.

Source: Kummerlowe, David L., "Computer-Aided Management of Emergency Operations," The International Fire Chief, January 1987, p. 13.

(3) Codebreaker. This component is a chemical identification database containing thousands of synonyms, identification numbers, color and odor characterizations, and labeling conventions, each cross referenced with standard names and numbers used in the transportation industry. The code may be activated by having the computer search its identification files for one or more characteristics, such as a chemical's odor or trade name.

(4) Chemical database. The chemical data base contained in CAMEO was developed to streamline the transfer of information from expert sources to the on-scene responder. A database was designed that compiles text from the best available reference sources. Subjects most critical to firefighters were emphasized, including personal protective measures, fire and explosion hazards, firefighting, etc. References were selected that were written in terminology familiar to firefighters; these include the U.S. DOT's Emergency Response Guidebook (Reference 2), the Emergency Action Guides Emergency Handling of Hazardous Materials in Surface Transportation (Reference 8), the U.S. Coast Guard's CHRIS System (Reference 6), as well as a number of other chemical references. Supplementary information, where necessary, was developed by NOAA and the Seattle fire department. CAMEO operates on the Apple MacIntosh SE and is used as a portable system mounted in emergency response vehicles. CAMEO is a part of the public domain and, as such, is free.

b. Phoenix, Arizona

The fire department of the city of Phoenix developed Computer-Aided Dispatch (CAD) and Mobile Digital Terminal (MDT) systems. These systems were developed to support the needs of three fire departments serving an area of 540 square miles (population of 1,350,000), with an estimated 225,000 dispatches annually. The present system was designed for 200 fire and emergency service vehicles, 65 fire stations, 16 dispatch consoles, and 24 remote administrative locations.

The heart of the system is three complete and separate Digital Equipment Corporation PDP 11/44 computer systems. Each one is capable of supporting the entire CAD/MDT system. Significant attention has gone into the dispatcher's requirements. For example, of the 12 radio dispatch consoles, 2 have the addition of emergency medical patient monitoring as well as hospital-to-emergency medical radio channel patching. Redundancy is built into the console system.

Also at the dispatch centers is a common visual display of the emergency vehicle status in the form of a wall map with indicator lights for the various types of emergency vehicles. The display indicates the current status of engines, ladders, ambulances, and command officers. Special indicators are provided to show temporary street closures, time, date, and current incident number. The display is used to monitor the placement of emergency vehicles to ensure minimum response time to any area.

The MDT, as used by the Fire CAD/Communication System, is a data terminal that meets the requirements of the fire vehicular environment. It provides reliable communication through its 800-MHz mobile radio unit. One hundred and fifty-two MDT units receive, display, or transmit information to support the fire and emergency medical service delivery to all first-line emergency vehicles. The units can also communicate information to and from Fire Alarm Headquarters, other MDTs, fire station terminals, as well as administrative terminals.

With a request for service, the MDT displays the address, type of emergency, units assigned, radio channel, dispatch type, time of dispatch, incident number, battalion area, comments, hazards, incident source, resource deficiencies, ambulance needed, temporary condition information, map page number, and building drawings and maps.

When general building floor plans are needed, tabular and graphic information is available on entrances, stairwells, fire protection connections, main electrical shutoff, main gas shutoff, elevator locations, and HAZMATs quantities and storage locations.

A variety of hazardous information is provided including: business/occupancy address, business/occupancy name, date of entry, revision, hazard type (NFPA ratings), health hazard number, flammability hazard number, reactivity hazard number, and special information and comments.

The CAD/MDT System is used for many other functions than emergency response. Information on about 6000 chemicals is contained, but no atmospheric computer code is incorporated. The CAD/MDT System is large, well designed for redundancy, and initially cost about 5.5 million dollars. A major software developer was Planning Research Corporation.

In comparing CAMEO and CAD/MDT, the differences are quite apparent. The two systems are considered to bound the needs expressed by the AF personnel in the four bases visited. The systems represent clearly different perspectives and operating philosophies. One is entirely self-contained and the other is highly dependent on radio communications to provide the actual computational power, which is housed in a centralized (and redundant) computer system.

H. TOXIC MATERIALS TRANSPORT MODELS AND SOURCES OF METEOROLOGICAL DATA

1. Types Of Atmospheric Transport Models

Atmospheric transport and diffusion models should be selected according to the required criteria. Different AF bases have different needs, not all of which are well served by any given model. Although this concept may seem rather obvious, many models are not properly

selected or used. The characteristics of interest may include (1) input requirements, (2) machine requirements, (3) operator skill necessary to operate or interpret the results, (4) outputs provided by the code, and (5) timeliness of the results.

The input required to properly predict atmospheric transport and diffusion is both meteorological and source. Without accurate, or at least realistic source term data, no reliable predictions can be made. With detailed source data, such as release rate, release temperatures, and release velocity, sophisticated codes provide more accurate estimates than do simple codes.

Atmospheric input data are somewhat more complicated. The data must either accurately represent the atmospheric environment, including transport and diffusion characteristics, or the code must generate a wind field from physical principles. Given the cost, complexity, and nature of codes capable of creating fields from boundary conditions, it must be assumed that the wind field will be derived from meteorological tower data. Depending upon the terrain, the type of release under study and the duration of the release, data from multiple towers may greatly improve the results. If so, the code must be capable of using the information provided.

The machine dependence of a model is of interest. If a code requires the services of a mainframe computer, the system will be bound by communication systems from the source of the data, the location of the computer, and the site of the OSC. Communications often represent the weakest link in a system and are common causes of failure. If an onsite (portable) system is selected, the cost of the computer must be evaluated. The computer must either be "dedicated," or the emergency response role must be given the highest priority on the system. At present, a fully reliable, cost-effective communications system that allows fast, smooth transfer of data and results from location to location during an emergency is difficult to obtain. Results of field programs and systems tests have demonstrated this point numerous times. Due to the potential for machine failure at the most inopportune times, the ready availability of backup machines is also a consideration in machine selection.

The skill of the code operator will determine the complexity of the code and its required input. If a trained dispersion meteorologist and perhaps a dose assessment expert are always available with response time appropriate for the problem, the code can be very flexible, with numerous input strings available to ensure the most appropriate output product. If the response personnel are trained technicians who must perform with possibly other assigned tasks, the code must be simplified to reduce the potential for errors. Simple input menus with automatic data collection and checking, in conjunction with predetermined defaults, improve system reliability.

The results from the codes will be used in the decision-making process. The form and format of these results should be tailored to

meet any requirements placed on the OSC, such as regulatory standards or values at predetermined locations. Information contained on the output should readily identify the problem under study and must be in a form that can be transferred to other locations, if required. The outputs must be legible, useful, and fast. The users of the results must be aware of the accuracy and reliability of the results, either through direct knowledge or through error bands that are included with the results.

Computer codes that require wind field data must use the wind fields captured in a tower network. If only a single tower exists, the system will be limited by this input. Multiple towers can capture the effects of changes in windspeed and direction as material moves from the release point. Therefore, the code employed should be capable of using this information. Gaussian plume models cannot incorporate the effects captured by multiple towers, so they are not recommended for use at sites with varying terrain or long (beyond a few kilometers) distances of concern. Codes using complex first-principle equations to drive wind fields do not run in a timely fashion on PCs, so these codes can be excluded from further consideration.

All of these arguments and considerations indicate that a code capable of operating in an IBM PC-AT or equivalent environment, using data from multiple towers, represents a realistic emergency response code. The "puff" codes, simulating releases as puffs of material, meet these considerations. Other benefits of these codes with direct application to typical emergency response needs include a decoupling of transport and diffusion, so the codes work well in light winds and the ability to track material after emission has ceased. Estimated transport times can be generated; thus, the codes can also provide useful information for planners. If the travel to a specific location is predicted to take 2 hours and the response only takes 15 minutes, the planner has the luxury of time to assess the real source term and to send monitoring teams to the affected areas for checks on the predicted concentrations. Puff codes also provide time-exposure estimates so the health response can be better estimated. This dose output would be of great value in determining appropriate protective actions, as well as required notifications.

More sophisticated codes do exist. The particle-in-cell codes are quite useful for deposition work, and they handle multiple release well. However, the particle-in-cell codes have significant problems with near-field concentrations, require larger computers or more running time than do puff codes, and have not been proven (in independent evaluations) to be better than the puff codes. Other codes cannot be run on small computers, and simulation times of 5 to 15 minute for each hour of estimated concentration make them unwise for most applications.

Puff codes are now employed in emergency response centers for nuclear reactors and many chemical facilities. Some are under consideration for use at Army nerve gas installations. These puff codes, with radiological dose conversions where required, are probably the best

presently available tools for emergency response applications. Based on experience, puff codes can be expected to estimate hourly average concentrations within a factor of 5 about 90 to 95 percent of the time, given an areal coverage of about 10 degrees either side of the predicted trajectory. Even with an abundance of data, such as upper-air information and balloon releases (not likely to be available at any site), more sophisticated codes may only shrink the uncertainty to 7.5 degrees either side of the trajectory and do no better with commonly available data.

Soon to come will be a new interactive Gaussian puff model called AFTOX (Air Force Toxic Chemical Dispersion Model), which is being prepared for the Air Weather Service by the AFCL. This program is written in Z-basic, operated under MS-DOS version 2.0, and designed to run on the Zenith Data System Z-100 microcomputer. The program will compute hazard distance resulting from toxic chemical releases. Releases may be continuous or instantaneous, liquid or gas, elevated or surface releases from a point source. The program contains additional options for continuous heated plumes from stacks. Users must enter appropriate meteorological and source characterization data. Detailed chemical data needed for calculations are stored for 64 chemicals. If an incident occurs with a material not in the data base, certain default features are available.

2. Sources of Meteorological Data

At AF bases with major flying missions, meteorological data are available through the base weather station of the Air Weather Service. These data can be provided to the fire chief in terms of parameters such as wind speed, direction, and stability needed to input to a computer code used to estimate a toxic corridor or evacuation zone. These data are taken from instrumentation primarily intended to assist flight operations. Usually, only one tower is used; thus, wind field data are unavailable. In principle, on-line meteorological data are possible; thus, required input for operation of a puff model is potentially available for one location. Optimally such data would be obtained from several distant sources but the ability to input continually changing meteorological data could aid in the predictive capacity of a puff-type model.

In the event of an incident for which the DRG is assembled, the base weather station is notified of the situation through Base Operations. Using a documented procedure (TR-80/001), a toxic corridor calculation (length and width) is performed and this is overlaid onto the base map. At this point the weather station awaits the request for information from DRG; once this is provided, DRG makes the decision regarding evacuation.

SECTION III

AIR FORCE FIRE DEPARTMENT HAZMAT INCIDENT MANAGEMENT PLANS

A. INTRODUCTION

This section of the report provides the Air Force with a number of plans and a strategy directed toward the development of a uniform Hazardous Materials Incident Management System (HMIMS), consisting of twelve main items. They are as follows:

1. Areas of responsibility and roles for response agencies
2. Requirements for personnel to handle HAZMAT incidents
3. Procedures for recognizing, stabilizing, controlling, and cleaning up of HAZMAT incidents
4. Procedures for decontamination
5. Decision-making criteria for personnel evacuation
6. Postincident evaluation and feedback
7. Bioenvironmental/medical evaluation responsibilities associated with HAZMAT incidents
8. Participation of emergency response personnel in IRP contract development and associated health and safety plans
9. HAZMAT inventory requirements and options for implementation
10. Personal protective clothing, equipment, and materials to handle HAZMAT incidents
11. NSN for equipment, materials, and clothing for HAZMAT incidents
12. Mutual aid requirements and response agency actions

B. AREAS OF RESPONSIBILITY AND ROLES FOR RESPONSE AGENCIES

This subsection addresses the areas of responsibility and the roles for each agency during response to HAZMAT incidents. The baseline was the data and information gathered during evaluation of the interface between the users and responding action agencies at HAZMAT emergencies. Identification of the responsibilities of response agencies was based on AF, DOD, and other related policy documents. Other material was derived from incident response procedures used by HAZMAT emergency response teams in the private sector.

The makeup of the HAZMAT incident response team will vary by AF command, by the size and the mission of the base, and by the needs of a particular emergency. Personnel of 11 different agencies may become involved during HAZMAT spill response. They include the fire department, OSC, security police, CE, BEE, public affairs office, base medical treatment facility, transportation squadron, weather squadron, disaster preparedness office, and user agency. Each agency's responsibilities and roles are presented below.

1. Fire Department

The fire department's around-the-clock requirement to deal with emergency situations makes its involvement with HAZMAT incidents a natural occurrence. They should be the first respondents to the HAZMAT incident. The fire department's duties should include recognition of the HAZMAT(s) and control/containment and stabilization of the spilled material. They should also provide on-scene command and control, onsite rescue, and fire extinguishment, as necessary. The fire department's responsibilities should include the following:

- a. Provide firefighters with protective clothing and equipment
- b. Respond directly to the scene of a HAZMAT emergency
- c. Obtain available information about the HAZMAT accident
- d. Plot the grid coordinates, consider wind directions and determine an initial entry control point location
- e. Secure the area and prevent unauthorized personnel from entering until the security police arrive
- f. Remove medical casualties
- g. Perform firefighting and/or rescue operations
- h. Stabilize and control/contain the spill/release of the HAZMAT
- i. Shutdown utilities as required
- j. Direct and control the operations at the spill site until the OSC arrives and assumes command of the situation
- k. Contact on-base agencies as directed by the OSC
- l. Upon arrival of the OSC, brief the status of the incident (i.e., the number of casualties, property damage, and the need for assistance) and provide technical assistance with respect to response to and handling of combustible or flammable substances

2. On-Scene Commander

The OSC should be either the Base or Vice Commander, or his representative. In the event of a HAZMAT spill or release, the OSC should direct and coordinate all emergency response actions. This person should have the authority to utilize the expertise and resources of the HAZMAT incident response team in determining and performing response actions. The OSC's responsibilities/roles should consist of:

a. Activating or authorizing activation of appropriate members of the spill response team based on information relayed during the initial notification and/or information provided after initial investigation of the reported spill

b. Determining the source, type, extent, and appropriate quantity of the spill substance

c. Evaluating the magnitude and severity of the threat to public health, welfare, and natural resources

d. Making sure actions have been taken to: remove and treat medical casualties, fight fires, evacuate the area, establish the cordon, and shut down utilities as required

e. Taking appropriate safety precautions to protect response personnel and personnel located near the probable spill route

f. Ensuring that all people leaving the spill scene are properly decontaminated and cleaned by the medical authority

g. Determining the party responsible for the spill

h. Determining the cause and instituting appropriate action to stop the source if the spill is still occurring

i. Instituting spill containment procedures

j. Determining if highly vulnerable areas such as water supplies, regional waste water treatment plants, or recreational waters might be endangered and notifying appropriate personnel or organizations

k. Determining if a reportable spill has occurred and notifying appropriate regional, state, and AF command EC as soon as possible

l. Assuring that the BEE has taken samples to determine the chemical nature, concentration, and extent of the spill as required for response actions and documentation

m. Advising the public affairs office of the size and nature of the spill and response action

- n. Approving the initial news release to the media
- o. Initiating cleanup actions
- p. Assuring the proper disposal of the spilled HAZMATs and associated contaminated material
- q. Assessing the damage caused by the spill and initiating efforts to restore the environment to the prespill condition
- r. Ensuring that emergency equipment is restored to full operational status
- s. Developing corrective action plans to ensure that the spill or similar spills do not occur again
- t. Making an operation(s) event/incident report for all spills classified as "major" or that interfere with the mission of the base

3. Security Police

The security police should respond immediately to an actual or potential HAZMAT spill to isolate the spill area and to control traffic when and where necessary. They should be responsible for:

- a. Setting up and maintaining the cordon and controlling the activities at the entry control point
- b. Supervising all security measures at the spill scene
- c. Evacuating all threatened areas as required
- d. Keeping the OSC advised on security

4. Civil Engineering

Since the fire department at most AF bases is a part of CE, CE must provide the initial response. CE's primary roles and responsibilities should include:

- a. Providing a CE response force with trained personnel, materials, and equipment to assist with containment, cleanup, restoration, and repair
- b. Providing a liquid fuels maintenance representative who will report to the scene, measure explosive vapor concentrations, and determine where explosion hazards exist
- c. Identifying the utility cutoff points and informing the OSC on the status of affected utilities and facilities

d. Keeping the OSC advised on hazardous pollutants, oil spills, and toxic chemical response actions

e. Assessing damage to government property

5. Bioenvironmental Engineer

The BEE's role during response to HAZMAT spills should be oriented toward determining the chemical nature, pollutant concentration, and extent of the release. The responsibilities of the BEE should consist of the following activities:

a. At the direction of the OSC, sample and test the affected environment to monitor the extent and degree of pollution caused by the spill

b. Provide technical assistance and advice to the OSC and the hospital with respect to:

- Allowable short- and long-term exposure limits associated with the HAZMATs

- Applicable environmental quality standards/criteria

- Required protective clothing

- Decontamination protocols

- Containment control measures

- Environmental factors to consider during rescue

c. Provide an estimate of the source strength for toxic chemical spills

6. Public Affairs Office

The public affairs office should act as the OSC's liaison and spokesperson in regard to dissemination of HAZMAT emergency information to the public. The office should respond to all HAZMAT spills when requested by the OSC. Its roles and responsibilities should be to:

a. Keep abreast of all base actions during the incident to provide prompt and accurate news releases on the nature of the discharge and the steps being taken to correct the problem

b. Prepare news releases

c. Coordinate and clear all news releases involving base actions with the OSC and the base commander

d. Disseminate news releases to the news media

7. Base Medical Treatment Facility

The base medical treatment facility should dispatch medical personnel and ambulance(s) to the site of the spill as directed by the OSC. Its roles and responsibilities should include:

- a. Performing triage and emergency medical actions
- b. Removing injured personnel to the base hospital for treatment
- c. Providing the OSC with current and followup information on injured personnel as soon as possible

8. Transportation Squadron

The base transportation squadron has an arsenal of motor vehicles. During response to HAZMAT emergencies, they should be responsible for providing the OSC with surface transportation as required for HAZMAT response personnel and equipment.

9. Weather Squadron

The base weather squadron must provide weather reports and keep track of weather conditions throughout the base. During response to HAZMAT spills it should:

- a. Provide the OSC with up-to-date weather information as required to support the emergency
- b. Calculate the winds aloft
- c. Assist in calculating dispersion and downwind concentrations of airborne contaminants

10. Disaster Preparedness Office

The disaster preparedness office must implement the base's DPO plan during attacks, natural disasters, and major accidents. During response to HAZMAT emergencies, it should, upon request from the OSC, provide a representative to the site of the spill to ensure that HAZMAT spill response and disaster response activities are coordinated if both plans (i.e., SPR and DPO) need to be implemented.

11. User Activity

The user is any person, organization, or agency that transports, stores, uses, and/or disposes of a HAZMAT. His/her responsibilities during response to HAZMAT incidents should consist of detecting and reporting HAZMAT spills and assisting the response team in identifying the spilled/released material. Upon recognizing that a HAZMAT spill has taken place, the user should:

- a. Activate the emergency alarms
- b. Evacuate the area, if warranted by the type of spill
- c. Make sure that all employees shut down their operations and secure their equipment
- d. Call the fire department and provide its name, the type of HAZMAT spilled, the location of the emergency, and the estimated quantity of HAZMAT spilled
- e. Inform its immediate supervisor
- f. Contain the spill if it can be done safely
- g. Make sure that an employee roll call is conducted to discover whether any personnel are trapped in the affected area
- h. Cleanup known HAZMATs in quantities less than reportable limits defined in local regulations and within the user's capabilities
- i. Assist the fire department upon its arrival

C. REQUIREMENTS FOR PERSONNEL TO HANDLE HAZMAT INCIDENTS

The personnel requirements for a HAZMAT incident response team at AF bases were identified, using the background gained during the site visits to AF bases and extensive study of HAZMAT incident response situations. The labor force required by the 11 agencies who may become involved during HAZMAT spill response was determined through review of the results from the study of the existing interface between the users and responding action agencies at HAZMAT emergencies. The requirements for each agency are presented below.

1. Fire Department Personnel Requirements

If the AF fire departments are to respond effectively and efficiently to HAZMAT incidents, between 11 and 13 people are required at each base. Some of the people on the HAZMAT incident response team may be able to fill dual positions. The labor force requirements are as follows:

- a. Senior Fire Officer (SFO): 1
- b. Fire communications center operator (FCCO): 1
- c. HAZMAT incident response team
 - Team leader: 1

- Team information officer: 1
- Team safety officer: 1
- Reconnaissance personnel: 2 - 4
- Entry and backup personnel: 4

As the highest ranking fire department representative at the scene of the emergency, the SFO should be responsible for determining the number of fire department personnel needed to respond to the incident and for directing/controlling the operations at the spill site until the OSC arrives and assumes command of the situation. The FCCO should be responsible for recording information from the HAZMAT spill discoverer, planning the approach route for the response team, and dispatching fire department equipment and personnel to the HAZMAT emergency site.

The HAZMAT incident response team is a crew of specially trained fire personnel who perform emergency control, containment, and stabilization during a HAZMAT spill. The team leader should be responsible for supervising the response team and managing the response to the HAZMAT emergency. The team information officer should be responsible for the assembly and analysis of all technical reference material, incident data, and other resources. He should also be responsible for positively identifying the HAZMATs involved at the spill site and the mitigation protocol and procedures. The team safety officer should be responsible for ensuring that safe and accepted practices are adhered to throughout the course of the emergency response, for the welfare of all people operating in the hot and warm zones. The reconnaissance (RECON) personnel should be responsible for developing information on the physical layout of the incident site and other factors influencing the HAZMAT emergency. Their primary task should be to generate a complete picture of the existing and anticipated conditions. The entry personnel should be responsible for entering the emergency area, sizing up the situation, stabilizing, controlling, containing the hazard, and rescuing people as the situation dictates. The backup personnel should be responsible for rescuing, assisting, and relieving the entry personnel, if necessary.

2. Requirements for a HAZMAT Van and Additional Personnel

Each fire department must have a dedicated vehicle/van for response to HAZMAT incidents. The van would provide a means of transportation for a designated number of the firefighters to and from the spill site. Additionally, it would carry HAZMAT incident response related documentation and literature and the HMIMS hardware and software. The van would also be used to store the protective clothing, equipment, and materials needed to mitigate the incident. Consequently, the van must be big enough to provide service for the above designated activities with some consideration for future expansion in the HAZMAT operational arena. Of the four bases visited, each already had a HAZMAT response van or had a vehicle on order.

Currently all personnel that fire departments need to appropriately respond to HAZMAT emergencies are supplied from within their own authorized/allocated resources. Three, full-time positions per shift (i.e., nine people) need to be created within each fire department so that firefighters can respond to HAZMAT spills and releases. Suggested titles for the three personnel are: team leader, assistant team leader, and driver. The team leader should assume the role of HAZMAT incident response team leader and, possibly, the position of the safety officer, in the case of small spills, during response to a HAZMAT emergency. His day-to-day responsibilities would include: supervising the assistant team leader and driver, providing HAZMAT spill response training to fire department personnel, aiding other on-base agencies in the training of their response personnel, and participating in HAZMAT emergency-related committees and other base-wide incident response activities (e.g., briefings and courses).

The assistant team leader should be the team information officer, who would coordinate/facilitate the activities of the reconnaissance personnel during spill response.

The driver should drive the HAZMAT incident response vehicle to and from the spill site and coordinate the donning and doffing of protective clothing of the entry and backup personnel. During nonemergencies, the assistant team leader could be responsible for maintaining an accurate inventory of the HAZMATs on base (i.e., location and quantity) and keeping up to date on the HAZMAT spill response literature. The driver could be responsible for performing corrective and preventive maintenance on the HAZMAT response van and restocking the vehicle with the required personal protective clothing, equipment, and materials for handling HAZMAT incidents. Both of these people should aid the team leader in the training of fire department personnel.

These two requirements, a response vehicle and personnel, should be added to AF Materiel Specification 4426 (AF Headquarters, Fire Operations, 1 July 1987). The response vehicle listing could be included in Table 1 (positions to support a base fire department with a crash fire protection responsibility) and Table 2 (positions to support a base fire department without a crash fire protection responsibility) of that document. The title of the vehicle listing could be "HAZMAT incident response" and the entries in the matrix under the heading "number of positions allowed" should be three.

3. Personnel Requirements for Other Agencies

The personnel requirements for the other 10 agencies who may become involved during spill response varies, depending on the needs of a particular incident. The agencies and the minimum number of people required to mitigate an anticipated HAZMAT incident are shown below; the numbers may increase if a more serious threat is encountered.

- a. OSC: 1
- b. Security Police: 2
- c. CE: 2
- d. BEE: 1
- e. Public Affairs Office: 1
- f. Base Medical Treatment Facility: 2
- g. Transportation Squadron: 1
- h. Weather Squadron: 1
- i. Disaster Preparedness Office: 1
- j. User Agency: 1 - 2

D. PROCEDURES FOR RECOGNIZING, STABILIZING, CONTROLLING, AND CLEANING UP OF HAZMAT INCIDENTS

This subsection clarifies the AF fire department's duties with respect to the terms "recognize," "control/contain," "stabilize," and "cleanup" during HAZMAT incidents. It also provides generic response procedures for the fire department's roles and responsibilities and for each type of personnel performing these duties. In addition, this subsection discusses response to HAZMAT emergencies during IRP activities.

The generated procedures follow the Eight-Step Process (Reference 5) for HAZMAT incident management where possible. During the generation of the procedures, information and advice obtained during site visits and from existing AF spill prevention and response plans, as collected during the examination and evaluation of the existing interface between the users and responding action agencies at HAZMAT emergencies, were considered.

1. Definition of Terms

a. Recognize

The term "recognize," when applied to the HAZMAT incident response situation, deals with two distinct tasks. The first is to detect the presence of a spilled HAZMAT; the other is to identify the specific HAZMATs released. Detection starts the response process and is the responsibility of the user agency. This task is performed through use of the human senses (e.g., seeing the spilled material, smelling the odor, hearing odd noises, and feeling dizzy). Identification is

conducted through a number cues. They include: the location of the spill and/or occupancy of the area, the shape and color of the container, the placards, labels, and markings on the container, the color and smell of the HAZMAT, and the shipping papers and other documents identifying HAZMATs.

b. Control/Contain

The term "control" has two operational definitions when used with HAZMAT incident response. The first use is in the control of the people and response at the spill scene. When applied to people, the word means keeping humans away from the hazard. This type of control can take two forms: isolation of the site and evacuation of the at-risk populations. When the term is used in regard to response, it means directing the people who are mitigating the HAZMAT incident.

Another definition of the word control relates to the HAZMAT itself. In this case control refers to the prevention of the spread of contamination beyond the present boundaries. There are several ways of obtaining this kind of control (e.g., containment, stabilization, treatment, and cleanup). (Control in this sense can also entail allowing a HAZMAT fire to continue to burn until it is consumed and converted to nontoxic substances.)

Containment exists at two levels. The first is the act of stopping the spread or propagation of the spilled/released HAZMAT into the environment and away from areas remote from the source of the spill. This can usually be accomplished without coming in direct contact with the released HAZMAT. In this case, the definition of "contain" implies site containment and chemical neutralization, both of which can be subsumed under the term stabilization. Site containment includes such methods as the building of dams, berms, dikes, trenches, booms, and barriers in soil and the use of curtain barriers and portable catch basins. Containment can also take the form of foam, liquid, gas or physical solid cover or burial, and in situ encapsulation. In addition, blowers and mist knock-down may be used for containment of gaseous HAZMATs.

The second usage of "contain" refers to the prevention of further spillage from the container that the HAZMAT is in. This set of methods is sometimes called offensive tactical operations. Containment techniques include patching, plugging, reorienting the container, transferring the HAZMAT into a new container, or placing the entire leaking container into another, larger container. Patching and plugging methods may range from very simple devices, such as wooden plugs, to rather large, detailed assemblies, such as chlorine kits.

c. Stabilize

The term "stabilize" has three HAZMAT incident response-related meanings. The first deals with a volatile substance reacting in some way to create a dangerous situation. In this instance, stabilization means removal of conditions that might initiate generation of the

HAZMAT or reactions to lead to disasters such as forming of a fireball called BLEVE (Boiling Liquid Expanding Vapor Explosion). The second definition addresses the chemical neutralization or treatment of a HAZMAT, which is hazardous because of certain reactive properties. The third meaning of the word "stabilize" is synonymous with the terms containment or control of the HAZMAT.

d. Cleanup

Cleanup is defined as the removal of the HAZMAT from the environment and includes such procedures as neutralization, dilution, treatment, and displacement. Dilution entails the addition of water, air, or solid materials to the HAZMAT to the point where the concentration of the substance is no longer an immediate threat; the chemical nature of the HAZMAT is unchanged. Treatment includes: absorption, granular media filtration, gravity separation, evaporation, steam stripping, application of activated carbon, absorbent resins and gels, chemical dispersion, extraction, ion exchange, hydrolysis, photolysis, neutralization, chemical oxidation, incineration, open burning, wet air oxidation, ozonation, and biological treatment. Treatment can be done onsite or materials may be moved to a secondary treatment facility. Displacement is the removal of the HAZMAT from the accident scene to either a secondary site or to permanent storage. Displacement methods include skimming, dredging, excavation, dilution and dispersal, and vacuum pumping.

2. Fire Department Duties During HAZMAT Incidents

The duties of the fire department must be restricted to recognition (identification), control/containment, and stabilization of the HAZMAT spill as defined above. The fire department is on call to respond to all base emergency situations. Consequently, it cannot dedicate all available manpower to long procedures needed after a HAZMAT incident. Cleanup should be left to another agency on base (i.e., either the people who made the spill or personnel properly trained to cleanup the spill) or to a subcontractor. The fire department's role during cleanup should be to monitor the cleanup to prevent further life or property damage. These recommendations appear to be in line with the guidance provided by AF Headquarters letter.*

3. Procedures to Recognize the HAZMAT Involved

a. Senior Fire Officer

(1) Respond to the HAZMAT incident

*See footnote in Section 11B.

b. Fire Communications Center Operator

- (1) Record what the problem is
- (2) Record where the problem is located
- (3) Ask what HAZMAT is involved
- (4) Inquire as to what form the HAZMAT is in:
 - Solid
 - Liquid
 - Gas
- (5) Ask if any vapor clouds, fumes, or spills were seen
- (6) Determine the wind direction and speed
- (7) Provide the SFO with the information acquired in the above steps

c. HAZMAT Incident Response Team Leader

- (1) Record the nature of the HAZMAT incident
- (2) Record the location of the HAZMAT spill
- (3) Record the date and time of the HAZMAT emergency
- (4) Identify the HAZMAT:
 - Develop an evaluation form on each HAZMAT
 - Obtain MSDSs from the BDE and prefire plans or shipping documents
 - Communicate with the on-scene personnel
 - Contact the manufacturer of the HAZMAT
 - Identify occupancy/contents of interior exposures

d. Information Officer

- (1) Determine the nature of the HAZMAT incident
- (2) Determine the location of the HAZMAT spill
- (3) Determine the date and time of the HAZMAT emergency

(4) Identify the contents of all exposed containers

(5) Consult at least three to five of the following information sources:

- HAZMAT Information System (DOD)*
- Emergency Response Guidebook (DOT) (Reference 2)
- Hazardous Chemical Data Manual for the Chemical Hazards Response Information System (Coast Guard) (Reference 6)
- Pocket Guide to Chemical Hazards National Institute of Occupational Safety and Health (NIOSH) (Reference 7)
- (Reference 9) - Fire Protection Guide on Hazardous Materials (NFPA)
- Emergency Handling of Hazardous Materials in Surface Transportation (Reference 8)
- Acutely Toxic List (EPA) (Reference 10)
- Oil and HAZMAT-Technical Assistance Data System OHM-TADS (EPA)**
- Dangerous Properties of Industrial Materials (Reference 11)
- MSDSs
- Shipping documents
- (CHEMTREC)** - Chemical transportation emergency center
- HAZMAT manufacturer

e. Entry personnel

- (1) Suit up in the proper protective clothing
- (2) Enter the hot zone
- (3) Identify the HAZMAT

*See footnote in Section IIB4.

**See footnote in Section IID.

(4) Size up the situation

(5) Relay information to the HAZMAT incident response team leader

4. Procedures to Control/Contain the Spill

a. Senior Fire Officer

(1) Determine the number of fire department personnel needed to respond to the incident

(2) Direct the fire communications center operator to notify other agencies as required

(3) Function as the OSC until the arrival of the Base Commander or his designated representative

(4) Implement fire and explosion abatement action

(5) Ensure that the immediate, contaminated area has been cleared of all personnel, as necessary, in conjunction with the security police

(6) Designate the entry control point and relay the coordinates to the FCCO

(7) Authorize the distribution of HAZMAT equipment from the HAZMAT response vehicle

(8) Make initial determination if the quantity of the HAZMAT spilled meets or exceeds the statutory reportable quantity for that material

(9) Provide technical assistance to the OSC, as needed

b. Fire Communications Center Operator

(1) Dispatch fire department equipment and personnel to the HAZMAT emergency site

(2) Plan the route of approach for the HAZMAT incident response team and from the upwind direction; pass it on to the SFO

(3) Request the spill discoverer to direct and aid the HAZMAT incident response team

(4) Contact other agencies as directed by the SFO

c. HAZMAT incident response team leader

(1) Assign the following personnel:

- Team information officer
- Team safety officer
- RECON personnel
- Entry and backup personnel
- Others (e.g., OSC, security police, BEE)

(2) Manage the spill site:

- Block and control access to the facility
- Isolate the hazard area (e.g., evacuate the room, floor, floors above and below, and building/facility)
- Obtain the isolation distance (hot zone) and the warm and cold zone distances from the team information officer
- Determine whether evacuation is required
- Designate a staging area for the HAZMAT incident response team

(3) Assess the hazards and risks:

- Check the integrity of the containers for:
 - Thermal stress
 - Mechanical stress
 - Corrosive stress
- Evaluate the HAZMATs for:
 - Health
 - Flammability
 - Reactivity
 - Toxicity
 - Physical and chemical properties
 - Environment
- Reevaluate hot zone to ensure that it is adequate
- Estimate the likely harm to personnel, property, critical systems, and the environment without intervention
- Evaluate whether further evacuation is necessary
- Meet with the HAZMAT emergency response team to discuss the current status of the incident
- Brief the OSC

(4) Select protective clothing and equipment:

- Obtain the required level of protective clothing for levels of protection I, II, or III (Reference 15) and suggested control agents from the BEE

- Brief the RECON personnel on:
 - Hazards
 - Assignment
- Obtain permission from the OSC for the RECON operation
- Monitor the communications of the RECON personnel
- Debrief the RECON personnel and retrieve data
- Brief the OSC

(5) Coordinate information and resources:

- Brief the entire HAZMAT incident response team on the current status of the emergency

- Meet with the representatives from other agencies to see if they have the capabilities to handle the incident

- Conduct a meeting of the on-scene personnel to review and discuss tactical options (e.g., defensive and offensive)

- Advise OSC of tactical options and recommendations.
- Brief all involved personnel on:
 - Options
 - Course of actions
 - Responsibilities and roles of each group

(6) Control the HAZMAT spill and stop leaks:

- Make sure that all HAZMAT incident response personnel are prepared for operations

- Brief the entry personnel on:
 - Hazards
 - Assignments
 - Emergency signals (i.e., hand and audible)
 - Personal protective clothing failure procedures

- Obtain permission from the OSC to commence operations

tions

- Monitor the communications of the entry personnel
- Coordinate with team safety officer during entry operations
- Establish schedule rotating entry and backup personnel.

d. Team information officer

- (1) Evaluate the HAZMATs for:
 - Health
 - Flammability
 - Reactivity
 - Corrosivity
 - Toxicity
 - Radioactivity
 - Physical properties
 - Chemical properties
- (2) Determine the isolation and evacuation distances and communicate the information to the HAZMAT incident response team leader
- (3) Determine the hot and warm zone dimensions
- (4) Record the weather information:
 - Current conditions
 - Forecast conditions
- (5) Record the location of the decontamination (DECON) area
- (6) Collect data from the RECON personnel:
 - Checklist
 - Site drawings
 - Photographs

e. Team safety officer

- (1) Record the nature of the HAZMAT incident
- (2) Record the location of the HAZMAT spill
- (3) Record the date and time of the HAZMAT emergency
- (4) Evaluate the positioning of the response team personnel and apparatus
- (5) Obtain the isolation and evaluation distances from the team information officer, establish the hot and warm zones, and communicate their locations to the HAZMAT incident response team leader

tion (6) Determine whether the command post is in a safe loca-

tion (7) Determine whether the staging area is in a safe loca-

(8) Determine whether the entry and backup personnel are in the proper protective clothing

(9) Inspect the personal protective clothing for:

- Imperfect seams
- Nonuniform coatings
- Tears
- Malfunctioning closures
- Pinholes
- Cracks
- Shelf deterioration
- Chemical attack (i.e., discoloration, swelling, stiffness, and softening)
- Punctures

(10) Inspect fully encapsulating suits (FES) for:

- Operation of the pressure relief valves
- Fitting around wrists, ankles, and neck
- Crack, crazing, and fogginess of the the faceshield

(11) Inspect respirators for:

- Tightness of all connections
- Signs of pliability, deterioration, and distortion
- Proper fitting
- Operation of regulators and valves
- Operation of alarm(s)
- Cracking, crazing, and fogginess of faceshields and

lenses

(12) Make sure that the entry team checklist is being followed and completed

(13) Make sure that the hazard and procedures briefing is completed by the HAZMAT incident response team leader

(14) Make sure that entry operations are being coordinated with DECON personnel

(15) Make sure that emergency warning signals are known by all HAZMAT incident response team personnel

(16) Make sure that the signs and symptoms of chemical exposure and heat stress are communicated to all involved personnel

(17) Restrict entry into the hot zone to HAZMAT trained personnel and individuals possessing particular knowledge of the problem/situation

(18) Monitor the entry personnel for signs/symptoms of chemical exposure and heat stress

(19) Remain in constant contact with the team leader and entry personnel

(20) Halt operations and order personnel back to the warm zone if unsafe conditions are observed

f. Reconnaissance personnel

(1) Record the nature of the HAZMAT incident

(2) Record the location of the HAZMAT spill

(3) Record the date and time of the HAZMAT emergency

(4) Perform communications check

(5) Obtain the required resources for RECON:

- Binoculars
- Monitoring instruments
- Camera
- Prefire plan
- Clipboard and pencil
- Utility maps
- Storm/sewer maps
- RECON checklist

(6) Coordinate with the HAZMAT incident response team leader prior to RECON

(7) Coordinate all data gathering with the team information officer

(8) Obtain the following information:

- HAZMAT containers
 - Type
 - Number
 - Condition
- Exposures
 - Life
 - Property
 - Environment
- Storm/sewer drains
- Topography
- Access/egress routes
- Wind direction and speed
- Ignition sources
- Water supplies
- Type of heavy equipment in the area
- Utilities
- Vehicles in the area and their contents

(9) Attempt to view the incident from all sides

(10) Enter the hot zone only after specific approval is received from the HAZMAT incident response team leader through the OSC

(11) Develop the incident site plan

g. Entry personnel

(1) Don the protective clothing in accordance with the manufacturer's checklist

(2) If there is a fire, extinguish it

(3) Rescue personnel as the situation dictates

(4) Suggest procedures for the stabilization, control, and containment of the hazard

(5) Stabilize, control, and contain the spill/release of the HAZMAT

h. Backup personnel

(1) Don the protective clothing in accordance with the manufacturer's checklist

(2) Be prepared to rescue the entry personnel

(3) Assist and relieve the entry personnel

(4) Furnish additional equipment and/or supplies to the entry personnel

5. Procedures to Stabilize the Spill

a. HAZMAT incident response team leader

(1) Terminate the HAZMAT incident response activities:

- Collect all hard data on the HAZMAT emergency

- Debrief all personnel on the incident

- Make sure that all personnel are aware of possible signs and symptoms of exposure to the HAZMAT

- Establish requirements for further medical monitoring

b. Team information officer

(1) When response to the emergency has been terminated, gather the checklists and notes from the HAZMAT incident team members

6. Installation Restoration Program

HAZMAT incidents may occur during IRP activities as well as during normal base operations. Several factors may distinguish an incident derived from an IRP activity as compared with an incident during normal base operation. However, the most important factors identified as personnel, location, and material (process) reflect only subtle differences from normal base operations.

a. Personnel

Essentially all IRP activities will be performed by subcontract personnel. The subcontractor will not necessarily be one of the local subcontractors who frequently perform work on base. The differences between familiar subcontractors and civilian or AF employees will be more important initially when the IRP subcontract personnel are

unfamiliar with normal base operation and the physical features of the facility. Since IRP work will be protracted at many sites, familiarity should increase with time and the issue will be of lesser importance.

b. Location

Unlike normal base operations, IRP activities are highly localized (although several sites may be under construction at any given time). Construction activities for many sites will primarily consist of locating and repackaging buried waste in preparation for shipment to an approved disposal facility. Incidents are most likely to result during this process rather than during transport of the HAZMATs. Thus, except in the event of a transportation incident, the incident respondents need only be concerned with the potential for an incident at a few possible locations at any given time.

There is not expected to be any substantial difference from normal activities in the potential locations for transportation incidents. Both IRP waste and normal waste must meet the DOT packaging and transportation codes discussed in Section II of this report and must be moved within base while enroute to the approved waste facility. No difference is apparent between IRP activities and normal operations in terms of possible incident location.

c. Material (Process)

Information gathered during this program points to a high degree of similarity between IRP chemicals and those used in normal operation at a given base. The only exception might be in the case when a base has accepted waste from another activity or where the mission or chemical use of a base has changed over time. It is important for the BEE to be in close touch with Phase II identification efforts and subsequent construction work. Use of materials with hazards different from those normally found on-base should be communicated to the appropriate incident response personnel.

Sometimes IRP construction may involve elaborate facilities designed to pump and clean groundwater or otherwise process large chemical volumes. The hazards posed by such operations may be different than those of normal base activities. Therefore, under such circumstances, the fire department must be aware of facility details. Walkthrough inspections with the BEE, as in standard base operations, should be performed. Interaction between the fire department and the IRP planning process is discussed in more detail in Section IIC2.

E. PROCEDURES FOR DECONTAMINATION

Decontamination is an important part of the response to HAZMAT incidents. DECON is defined as the process of reducing and preventing the spread of contamination (from persons and equipment) at a HAZMAT

incident. Personnel responding to HAZMAT emergencies and equipment used during spill mitigation may become contaminated in a number of ways (a few of which are listed below) and must be decontaminated before leaving the HAZMAT incident site:

1. Contacting vapors, gases, mists, or particulates in the air
2. Being splashed by materials while sampling or opening containers
3. Walking or driving through puddles of liquids, powders, contaminated soil, or vegetation
4. Using contaminated instruments or equipment
5. Skin contact with contaminated personal protective equipment (PPE) or clothing
6. Transporting contaminated personnel

DECON consists of physically removing contaminants or changing their chemical nature to innocuous substances. The degree and type of DECON needed depend on several factors, the most important being the type of chemicals involved. The more toxic the chemical, the more extensive the DECON process becomes. The exact procedure to use must be determined after evaluating a number of factors specific to the incident.

A DECON area must be established at each HAZMAT incident site if the situation warrants. This area should be manned by a decontamination officer and a group of two to three support personnel. The DECON officer should establish the decontamination area and ensure that all people leaving the spill scene are properly cleansed and receive a medical evaluation. The DECON group should be a dedicated team of specially trained people who can recommend DECON protocols and procedures to the OSC.

The AF has not as yet assigned the DECON role and responsibilities to any specific agency or group of agencies. The AF should study and evaluate the requirements of DECON further before making the decision. As part of this project a generic set of procedures for the decontamination officer and DECON group was developed. These procedures should be used by the agency assigned the DECON role at HAZMAT incidents. The procedures are listed below.

1. Decontamination Officer
 - a. Prepare for DECON:
 - (1) Identify the type and amount of HAZMAT

HAZMAT

- (2) Determine how contact with the HAZMAT could be made:
 - Contacting through the air
 - Splashing
 - Walking through liquids or contaminated soil
 - Using contaminated equipment
- (3) Determine health hazards and risks involved with the
- (4) Determine the effects of the HAZMAT on equipment
 - Corrosion
 - Decomposition
 - Degradation
- (5) Identify whether the HAZMAT is reactive with water and other substances
- (6) Confer with other specialists concerning DECON
- (7) Identify the most acceptable method of DECON
 - Dilution
 - Absorption
 - Chemical degradation
 - Disposal and isolation
- (8) Determine the correct DECON protocol to be followed (Reference 15):
 - Maximum DECON protocol for Level III (encapsulating) personal protective clothing
 - Maximum DECON protocol for Level II (nonencapsulating) personal protective clothing
 - Minimum DECON protocol for Level III personal protective clothing
 - Minimum DECON protocol for Level II personal protective clothing
 - Nine-step DECON protocol

(9) Determine what type of neutralizing agents are required and in what quantities

- Sodium hypochlorite
- Sodium hydroxide
- Sodium carbonate slurry
- Calcium oxide slurry
- Liquid detergents
- Ethyl alcohol
- Sodium phosphate

(10) Determine which DECON solutions are required
phosphate

- 5 percent Sodium carbonate and 5 percent Sodium phosphate
- 10 percent Calcium hypochlorite
- 5 percent Sodium phosphate
- Diluted hydrochloric acid
- Concentrated detergent

(11) Identify the symptoms for an acute exposure to the HAZMAT and pass this information on to all personnel

(12) Determine the "hot," "warm," and "cold" zones are and make sure that they are properly identified

(13) Determine where the entry and exit check points are and make sure that they are properly identified

(14) Determine how much of the DECON must be done by the HAZMAT incident response team and how much can be done by a cleanup contractor or the agency responsible for the spill

(15) Make sure that a DECON site is established and that it is:

- In the warm zone
- Upwind, uphill, and upstream
- Accessible to roads and water

- Free of physical hazards
- Not susceptible to harming the environment
- Properly marked and roped off

(16) Determine whether the DECON site should be located on soil or hard surface

(17) Determine whether DECON can be conducted safely

(18) Ensure that there is enough plastic to cover entire DECON site

(19) Determine which DECON stations are required

- Equipment drop in hot zone
- Boot cover and glove wash
- Boot cover and glove rinse
- Tape removal
- Boot cover removal
- Outer glove removal
- Suit/safety boot wash
- Suit/safety boot rinse
- Tank change
- Safety boot removal
- Suit removal
- Self-contained breathing apparatus (SCBA) tank
- Inner glove wash
- Inner glove rinse
- Facepiece removal
- Inner glove removal
- Inner clothing removal

removal

- Field wash
- Redress
- Medical checkup, fluid replenishment, and rest

(20) Ensure that DECON corridor is set up in a straight line

(21) Ensure that the DECON stations are at least 3 feet apart and have DECON procedure signs which can be read by personnel in personal protective clothing

(22) Determine the closest hospital that can treat this type of emergency and make sure advance coordination has been done

(23) Determine what local permanent buildings can be used for DECON

(24) Make sure that there is adequate shelter to protect personnel against the environment

(25) Make sure that there are enough of the items listed to meet the DECON requirements:

- Long-handled brushes
- Short bristle scrub brushes
- Galvanized wash tubs
- Buckets
- Plastic trash cans
- Plastic bags
- Plastic sheathing
- Wading pools
- Disposable towels
- Tables
- Chairs or stools
- Slippers and clean clothes
- Surgical soap, brushes, and sponges

- Personnel showers
- SCBA
- Disposable drums
- Beverages
- Weather-appropriate clothing

(26) Determine whether plastic bags will contain the contamination

(27) Determine whether the contamination will affect rubber

(28) Make sure that the emergency shower and eyewash have been set up and that they are functioning properly

(29) Make sure that water runoff will not affect any water source during the emergency

(30) Make sure that the DECON personnel are appropriately dressed for the type of exposure and HAZMAT

(31) Determine whether any type of medication is required onsite for emergency treatment and, if it is, make sure that it is available

(32) Make sure that the base medical treatment facility staff are set up (i.e., protection for them and their ambulance) to handle contaminated patients

(33) Make sure that baseline physicals are available for entry, backup, and DECON personnel

(34) Make sure that information sheets which provide appropriate guidance on the HAZMATs are prepared and ready to go with contaminated or suspected contaminated patients to the hospital

(35) Make sure that there is a chart posted which gives the symptoms and first aid procedures for heat rash, heat cramps, heat exhaustion, heat stroke, frostbite, and hypothermia

(36) Make sure that no DECON personnel have any open wounds and that none have taken alcohol or medicine recently

(37) Make sure that a transportation vehicle is available if the DECON area is more than 100 yards from the work area in the hot zone

(38) Make sure that plastic has been draped over the transportation vehicle and that respiratory protection is available for the driver

(39) During DECON make sure that:

- DECON and entry personnel have been briefed on DECON protocol will be utilized

- The selected DECON protocol is followed exactly

- Heart rate, blood pressure, body temperature, and weight are being taken on personnel who are wearing personal protective clothing

- Personnel are being observed for indicators of toxic exposure:

- Changes in complexion or skin discoloration

- Lack of coordination

- Changes in demeanor

- Excessive salivation or pupillary response

- Changes in speech pattern

- Inquiries are being made on other indicators of toxic exposure:

- Headaches

- Dizziness

- Blurred vision

- Cramps

- Irritation of the eyes, skin, or respiratory tract

- Fingers, toes, and ears are being checked on personnel coming through DECON when the temperature is cold

- Personnel are monitored for heat stress when the temperature is above 80°F

- Monitoring for contaminants at the DECON site is being done

- Swipe tests are being done on the skin of all personnel and on all protective clothing and equipment

- Contaminated tools and equipment and wooden and leather items are being kept in the hot zone

- During incidents which require chemical degradation, the mixing and application of chemicals is being performed correctly

- None of the DECON personnel is eating, drinking, chewing gum, or smoking in the DECON area

- The windows in the transportation vehicle are being kept closed when it is in the hot zone

- All personnel take showers and that areas such as the head, groin, and ears are emphasized during body washing

- All personnel departing DECON receive a medical evaluation

- Pieces of protective equipment are being wrapped separately to reduce the spread of contamination

- Overspray and splashing are minimized during DECON and water runoff is being diverted to a safe area

- During vehicle DECON the wheel wells and chassis are cleaned thoroughly and air filters are changed onsite and disposed of properly

(40) After the HAZMAT emergency is over, make sure that:

- The HAZMAT has been isolated, bagged, and placed inside plastic containers

- All other disposables have been properly placed inside overdrums

- All containers have been isolated from each other

- All pieces of equipment owned by the AF have been cleaned

- If clothing is going out for laundering, ensure that the bags are taped closed

- All personnel equipment is sanitized and sent to maintenance for inspection

- Permeation tests are conducted on the personal protective clothing
- All fire hose has been decontaminated and tagged for pressure test
- All appropriate documentation has been completed

2. Decontamination Group Personnel

a. Maximum DECON protocol for Level III personal protective clothing

- (1) Deposit equipment used onsite onto plastic drop cloths or in different containers with plastic liners
- (2) Scrub outer boot covers and gloves with DECON solution or detergent/water
- (3) Rinse the DECON solution from the outer boot covers and gloves using copious amounts of water
- (4) Remove tape from around boots and gloves and deposit in container with plastic liner
- (5) Remove boot covers and deposit in container with plastic liner
- (6) Remove outer gloves and deposit in container with plastic liner
- (7) Wash encapsulating suits and boots using scrub brush and DECON solution or detergent/water
- (8) Rinse off the DECON solution from the encapsulating suits and boots using water
- (9) Remove safety boots and deposit in container with plastic liner
- (10) Remove FES and lay it out on a drop cloth or hang it up
- (11) Remove hard hat
- (12) Remove SCBA backpack and place it on a table
- (13) Disconnect the SCBA hose from the regulator valve
- (14) Wash inner gloves with DECON solution that will not harm the skin

water (15) Rinse the DECON solution from the inner gloves using

(16) Remove facepiece and deposit in container with liner

liner (17) Remove inner gloves and deposit in container with

(18) Remove inner clothing and place into lined container

(19) Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present

(20) Put on clean clothes

b. Maximum DECON protocol for Level II personal protective clothing

(1) Deposit equipment used onsite onto plastic drop cloths or in different containers with plastic liners

(2) Scrub outer boot covers and gloves with DECON solution or detergent/water

(3) Rinse the DECON solution from the outer boot covers and gloves using copious amounts of water

(4) Remove tape from around boots and gloves and deposit in container with plastic liner

(5) Remove boot covers and deposit in container with plastic liner

(6) Remove outer gloves and deposit in container with plastic liner

(7) Wash chemical-resistant splash suit, SCBA, gloves, safety boots, and backpack assembly, using scrub brush and DECON solution or detergent/water

(8) Rinse the DECON solution from the chemical-resistant splash suit, SCBA, gloves, safety boots, and backpack assembly using water

(9) Remove safety boots and deposit in container with plastic liner

(10) Remove SCBA backpack and place it on a table

(11) Disconnect the SCBA hose from the regulator valve

(12) Remove splash suit and deposit in container with plastic container

(13) Wash inner gloves with DECON solution that will not harm the skin

(14) Rinse the DECON solution from the inner gloves using water

(15) Remove face piece and deposit it in container with liner

(16) Remove inner gloves and deposit in container with liner

(17) Remove inner clothing and place in lined container

(18) Shower if highly toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present

(19) Put on clean clothes

c. Minimum DECON protocol for Level III personal protective clothing

(1) Deposit equipment used onsite on plastic drop cloths or in different containers with plastic liners

(2) Scrub outer boots, outer gloves, and FES with DECON solution or detergent/water

(3) Rinse the DECON solution from the outer boots, outer gloves, and FES using copious amounts of water

(4) Remove outer boots and gloves and deposit in container with plastic liner

(5) Remove FES and inner gloves and deposit in container with plastic liner

(6) Remove SCBA backpack and facepiece and deposit on plastic sheets

(7) Wash hands and face thoroughly

d. Minimum DECON protocol for Level II personal protective clothing

(1) Deposit equipment used onsite on to plastic drop cloths or in different containers with plastic liners

(2) Scrub outer boots, outer gloves, and chemical-resistant splash suit with DECON solution or detergent/water

(3) Rinse the DECON solution from the outer boots, outer gloves, and chemical-resistant splash suit using copious amounts of water

(4) Remove outer boots and gloves and deposit in container with plastic liner

(5) Remove chemical-resistant splash suit and inner gloves and deposit in container with plastic liner

(6) Remove SCBA backpack and facepiece and deposit on plastic sheets

(7) Wash hands and face thoroughly

e. Nine-Step DECON Protocol

(1) Drop tools on their contaminated side

(2) Enter the DECON area

(3) Step into wash tub #1

(4) Confirm that all personnel are well and have an air supply

(5) Examine suit for breaches

(6) Scrub down contaminated personnel

(7) Open suit and disconnect breathing tube while instructing personnel to hold their breath

(8) Insert breathing tube into the regulator and insert the regulator into facepiece. Instruct personnel to exhale while making the connection

(9) If positive pressure breathing supply is not required, remove the SCBA

(10) Leave the facepiece in place

(11) Remove the SCBA harness and place it on a plastic sheet on its contaminated side

(12) Remove all duct tape from the facepiece, hood, gloves, and boots

(13) Place tape in disposal container

(14) Unzip protective clothing and turn inside out over gloves if possible

(15) Instruct personnel to stand still with arms apart. Undress the worker without his assistance to avoid contamination

(16) Instruct personnel to step out of inner boots

(17) Place contaminated clothing inside out in disposal container

(18) Exercise one of three options:

- Instruct personnel to shower and launder clothing
- Transport the personnel by vehicle to a fixed facility for supervised DECON
- Clean personnel onsite inside the warm zone

(19) Instruct personnel to remove undergarments and to soap and shower using personal cleaning kits

(20) Dispose of cleaning materials inside plastic bags

(21) Instruct personnel to dry off

(22) Clean all areas

(23) Dispose of all drying materials inside plastic bags and plastic bags inside plastic drums

(24) Don disposable coveralls

(25) Wrap injured personnel in sheet and blanket and place on backboard

F. PERSONNEL EVACUATION

Evacuation is defined as the collective mass movement of people and property away from a source of potential threat of injury, death, or damage. It is viewed as a process by which people form images of threat or risk and act upon available information in setting a course of action. Evacuations are either precautionary or protective. Precautionary evacuations are those in which people move away from a potential threat that fails to materialize. Protective evacuations are those in which people move away from a threat that does occur. This distinction is somewhat artificial in that both types are conducted to protect the public.

Evacuation of people is usually preceded by isolation of the threat area. During response to HAZMAT incidents, isolation should be one of the first steps taken, even if evacuation is to follow. Everybody who is not directly involved with response to the emergency should be kept away from the hazard area. Unprotected people should not be allowed in the area. Subsequent evacuation of personnel is sometimes, but not always, necessary. When evacuation does take place, it is perhaps the most sweeping response to an accidental release.

The AF does not have many major evacuations during a year, but a number of HAZMAT emergencies require the evacuation of small groups of people, both military and civilians. If a major evacuation is required, preparation must be made. AF bases must determine whether to notify and evacuate the areas, when to issue warning, the channel on which to communicate, the nature of the recommendations and instructions, and the content of the evacuation notifications. This subsection identifies tools and techniques to assist the AF in determining what distance to isolate the hazard area and when and how far to evacuate military personnel and potentially affected civilians during response to a HAZMAT emergency. The primary products were a list of decision-making criteria for personnel evacuation and a checklist that can help decision making by the base fire department as the first responders. The basis for the development of the end products included technical, logistical, environmental, health hazard, and human factors considerations.

1. Isolation and Evacuation Information from Site Visits to Air Force Fire Departments

During the site visits to the AF bases, response to HAZMAT emergencies was discussed with the fire department personnel. One of the topics considered was that of isolation/evacuation. The HAZMAT incident response team leaders at each of the bases said that they consult the DOT's Emergency Response Guidebook (Reference 2) for assistance in isolating and evacuating the spill area. One of the bases follows the eight-step process (Reference 5), which was discussed previously, during its response to a HAZMAT emergency. Step 1 deals with site management (i.e., isolate area/deny entry). The isolation distance depends on the HAZMAT(s) involved, the amount, the type of container, and the type of stress (e.g., thermal, mechanical, or corrosive) on the HAZMAT(s) and its container. When response personnel use available technical references to determine the initial isolation distances, all suggested isolation distances are doubled. Isolation of the hazardous area is accomplished by establishing hot, warm, and cold zones. The hot zone is where high hazard exists; personnel are not allowed to enter this area without a specific need and the correct chemical protective clothing. The warm zone is an area where potential hazards exist. It too is restricted to necessary personnel. The last zone is the cold zone where no hazards exist. The size and shape of the hot and warm zones depend on the HAZMAT(s) involved, their toxicity, their method of spreading the contamination (as a solid, liquid, or vapor/gas), the weather, and the terrain. The hot zone is evacuated by properly protected personnel. The OSC considers the extent of evacuation. He also establishes

priorities of who should be evacuated. If the spill occurs in a high rise or large facility, the OSC evaluates evacuating a couple of floors or area versus entire evacuation.

One of the bases has calculated evacuation distances for each building on base that uses HAZMATs. Building identification is ranged between 0 and 300, 300-600, and 600-900 feet away. The fire department has modified its facility prefire plans (Figure 20) to incorporate this information in item 17 of the plans. A drawing showing the building of interest and all buildings within 900 feet has also been prepared. Concentric circles with radii of 300, 600, and 900 feet have been placed on the drawing. Another base uses the three-zone concept during HAZMAT incident response. Upon arrival at the HAZMAT incident scene, a cordon is established as directed by the type and severity of the chemical involved. A minimum of 300 feet is classified as the hot zone, 1700 feet as the warm zone. Entry into the hot zone is restricted to HAZMAT-trained personnel and individuals possessing particular knowledge of the problem/incident.

2. Isolation and Evacuation Guidance from the EPA, DOT, and the National Oceanic and Atmospheric Administration (NOAA)

a. EPA

The EPA has generated draft Technical Guidance for Emergency Planning in regard to extremely hazardous substances (Reference 16). The purpose of the guide is to help emergency planners conduct a hazards analysis for airborne releases of HAZMATs. It is primarily concerned with the lethal effects of airborne substances on humans. Appendix I of the guidance manual provides general considerations for evacuation. The appendix states that the first consideration is to determine whether an evacuation is necessary. This decision involves a comprehensive effort to identify and consider both the nature of and the circumstances surrounding the released HAZMAT and its affect on people.

The appendix says that numerous factors affect the spread of HAZMATs into the area surrounding a leaking/burning container or containment vessel. The factors include: the amount of released material(s) (i.e., size and concentration), physical and chemical properties of the released HAZMAT(s), health hazards from a short-term exposure, dispersion pattern, atmospheric conditions, dispersion medium (e.g., air, land, and/or water), rate of release, and potential duration of the release. The first responders to an incident should carefully consider each of these factors to determine the conditions created by the release, the areas that have been or will be affected, and the health effects on people. Some of the factors that affect evacuation are described below.

Physical and chemical properties of a HAZMAT that should be identified are:

- (1) Physical state - solid, liquid, or gas
- (2) Odor, color, and visibility
- (3) Flammability - flashpoint, ignition temperature, and flammable limits
- (4) Specific gravity - will the material sink or float on water?
- (5) Vapor density - will the vapors rise or remain near ground level?
- (6) Solubility - will the material readily mix with water?
- (7) Reactivity - will the material react with air, water, or other materials?
- (8) Crucial temperatures - boiling and freezing points

Health hazards that should be investigated consist of: acute or chronic hazards; respiratory hazards; skin and eye hazards; and ingestion hazards. Questions about the dispersion pattern of the released HAZMAT are:

- (1) Does the release follow the contours of the ground?
- (2) Is the release a plume (i.e., vapor cloud from a point source)?
- (3) Does the release have a circular dispersion pattern (i.e., dispersing in all directions)?

Atmospheric conditions that may affect the movement of material and evacuation procedures consist of:

- (1) Wind - speed and direction
- (2) Temperature
- (3) Moisture - precipitation and humidity
- (4) Air dispersion conditions - inversion or normal
- (5) Time of day - daylight or darkness

Life safety factors to consider when planning an evacuation include the number and types of people who require evacuation and the resources needed to conduct a safe and effective evacuation. It is

critical to know whether the people are actually located in an area that contains hazards or whether they are located in an area only threatened by hazards. When considering people who are actually located within the hazardous area, the HAZMAT incident response team must decide to: order the people to remain indoors, rescue them, or initiate general evacuation. The "remain indoors" option is to be considered when the hazards are too great to risk exposure of evacuees. If an area is only threatened by a HAZMAT release, it should be determined whether potential evacuees can be evacuated before hazards reach the area. Safe evacuation may take hours.

Assuring a safe and effective evacuation involves the following factors: number of people involved, where they are located, their degree of mobility, and whether there are any communications problems. Potential evacuees may be found in different locations: residences, educational institutions, medical institutions, health care facilities, child care facilities, correctional facilities, offices, commercial establishments, manufacturing/industrial/research facilities, government facilities, places of public assembly, parks and other recreational areas, sporting arenas/stadiums, and roadways. In addition, the first responders should determine who will require special assistance in evacuating the area and whether there are barriers to communication between evacuees and evacuation assistance personnel. Special considerations are to be given to: persons lacking private transportation, the elderly, children, the handicapped, the infirmed, prisoners, and non-English-speaking persons.

To accomplish a safe and effective evacuation, the HAZMAT incident response team must have access to appropriate and sufficient resources including personnel, vehicles, and equipment appropriate for emergency situations. The agencies that would likely supply personnel during an evacuation operation are the security police, fire department, transportation squadron, base medical treatment facility, and Red Cross. Specially equipped vehicles might include: lift-equipped buses and taxi cabs for handicapped persons, ambulances for infirm and handicapped persons, and vehicles for transporting persons lacking private transportation. Prearranging the emergency availability of these vehicles results in a more timely and effective evacuation. The type of equipment needed during an evacuation includes: protective gear (e.g., masks to protect the lungs and protective covering for the skin and eyes) for Evacuation Assistance Personnel; protective gear for evacuees who may have to be taken through an area of heavy chemical concentration; communication equipment (e.g., portable and mobile radios, mobile public address systems, and bull horns); and evacuation tags (a tag or marker attached to a door to indicate that the occupants have been notified) for buildings that have been evacuated.

If it is decided that an area is to be evacuated, the evacuation must be conducted in a well-coordinated, thorough, and safe manner. Evacuation involves a number of steps. The first step is to assign tasks to evacuation assistance personnel. These tasks include information concerning: the specific area to evacuate, protective gear

to be worn, instructions to be given to evacuees, transportation of evacuees, assistance to special populations, shelter locations, security for evacuated areas, pedestrian and traffic control (i.e., restricting access of vehicles into the evacuated area and facilitating speedy vehicular movement out of the evacuation area), and communication procedures. The progress of the evacuation efforts must be monitored, and continuous direction to evacuation assistance personnel must be provided by those in charge to ensure that the evacuation is being conducted in a safe and effective manner.

The second step in an evacuation is to inform people that they must evacuate and to provide them with accurate instructions. This can be accomplished in several ways: door-to-door, public address system (from a mobile unit or within a building), and a combination of door-to-door and public address. The potential evacuees might also be alerted to the emergency by means of an alerting and warning system that prompts them to tune in to their radios for instructions.

The third step is to provide movement assistance to evacuees. This would include: arranging transportation for evacuees who are without private transportation, arranging for movement of the infirm and handicapped, traffic control, and encouraging evacuees to move along in an expeditious manner. Should evacuees become exposed to hazards during an evacuation, emergency medical care must be provided. If a hazardous vapor cloud suddenly moved upon a large group of people being evacuated, numerous casualties would be possible. Once an area is evacuated, law enforcement personnel must guard the area to prevent looting and other unauthorized actions.

The final step in the evacuation process is to provide shelter to the evacuees. Merely advising people to evacuate an area is inadequate. Shelters should be identified and management and operational procedures should be established as part of HAZMAT incident response preparedness.

b. Department of Transportation

The DOT has published a guidebook for response to HAZMAT incidents (Reference 2), with some guidance on both isolation and evacuation. In regard to isolation, it states that: everybody should be kept away from the hazard area if not directly involved with emergency response or the rescue operation; unprotected people should not be allowed into the area; and rescue operations should be conducted as quickly as possible, with rescue personnel entering the scene from the upward approach. Relative to evacuation, good judgment should be used in evacuation procedures to avoid placing people in greater danger than necessary. Topographic maps may be of assistance during the planning and execution phases of evacuation; preplanning should take place; HAZMAT incident response team training should be provided. The hazard area should be isolated and all people be removed from areas and buildings, in accordance with an isolation and evacuation distance table, which is presented in the back portion of the DOT document. Immediately preceding the table is a set of instructions on its use.

The table provides suggested distances for isolating and evacuating unprotected people from spill areas. The suggestions are only for the initial phase of an accident involving HAZMATs shipped in bulk or multiple-container loads. Continuing reassessment of the situation is necessary because there may be a change in circumstances. If a HAZMAT cloud goes between several multistory buildings or down a valley, the cloud may affect people much further away than the distance specified, and the evacuation distance should be increased for the downwind direction. The occupants of the upper floors of multistory buildings in the evacuation sector may be safer remaining where they are if the heating and air-handling equipment in the buildings can be shut down so that the hazardous vapors or gases will not be circulated within. A short-term spill cloud may be deflected or reflected by a multistory building and pass by without affecting the occupants or equipment within the building. If a fire begins to burn the spilled HAZMAT, the health hazard may become less important and the evacuation distances may not have to be as great as they were with no fire involvement. For some of the listed HAZMATs, the potential fragmentation hazards from a tank car or truck involved in the fire may require isolation in all directions for at least one-half mile despite any shorter distance suggested in the table. Whatever number of feet or miles has been cleared, if unprotected people are being affected by one of more of the HAZMATs in the table, then the distance should be increased and the situation reassessed.

c. National Oceanic and Atmospheric Administration

The NOAA has developed a prototype computer program entitled Computer-Aided Management of Emergency Operations (CAMEO) for assisting first responders during HAZMAT spills (References 13 and 14). One of CAMEO's main components is a data base of over 2625 chemicals. A response information data sheet has been assembled for each of the chemicals. One of the items on the data sheet is information on evacuation. The evacuation information was drawn from EPA's Technical Guidance for Emergency Planning and DOT's Emergency Response Guidebook (References 16 and 2). Priority was given to EPA's data; DOT's information was used only when data from the EPA were missing.

3. Evacuation issues

Sorensen, Vogt, and Mileti (Reference 17) identified and discussed 11 issues to be considered during evacuation planning for a HAZMAT emergency. The issues come from a variety of sources: research reports, critiques of evacuation planning, editorials, transcripts of hearings, litigations, and newspaper articles. They include issues related to the physical hazard, warning characteristics and social, organizational, and response factors. Physical hazard is defined as the nature of the threat; warning is the nature of the information dissemination process. Social issues are the pre-evacuation population attributes (i.e., psychological, demographical, and social characteristics). Organizational and response factors are defined as the attributes of emergency preparedness and response organizations and the behavior of people and organization in an evacuation, respectively.

a. Physical hazard issues

Physical hazard issues consist of uncertainty in the ability to specify hazard parameters, uncertainty in the ability to detect hazards, and hazard characteristics constraining evacuation effectiveness. The ability to make evacuation decisions depends on knowing the nature and behavior of the physical hazard creating the threat. This includes knowledge of the parameters of location and magnitude. The ability to specify the location is critical to good evacuation planning, because HAZMAT incident response teams need to know which areas to evacuate, given the specific threat. The prediction of the magnitude of the hazard's impact varies with the prediction of the area at risk when the magnitude of a HAZMAT spill determines the size of the area impacted.

The uncertainty in the ability to specify hazard parameters seems to arise for three reasons. First, most of the physical systems that cause hazards behave in a random or a stochastic way, which create probabilities and uncertainties for the evacuation planner. Second, the theories and models used to predict hazards are inadequate or fail to develop a means of accurate threat prediction. Third, the collection of data that could be used to obtain more accurate prediction is limited by technology or resources. The existence of a threat must be recognized before evacuation warning can be issued or people can be encouraged to move away from the threatened area. Some incidents pose difficulties for using evacuation as a protective action because the onset of the hazard is difficult to detect or specify. It is difficult to detect a release of HAZMATs until humans are exposed. The inability to detect hazards exists, partly, because currently available engineering expertise is not properly applied to the technology of detection and, partly, because of the lack of detection instruments. Detection technology and techniques for measuring harmful amounts of HAZMATs are sometimes either not available or not installed at locations where accidents occur. The speed of onset of some HAZMAT incidents is a major problem for effective evacuation for a subset of HAZMATs. Without adequate lead time, it is difficult to effectively move threatened populations. Many accident scenarios for HAZMATs have lead times ranging from zero to 30 minutes. There is not enough knowledge to optimize planning for fast-moving events.

b. Warning issues

Warning issues consist of uncertainty in the ability to alert and the lack of information. The inability to warn people to evacuate may result in greater exposure to risk. The inability to alert populations at risk may be due to a lack of warning systems, the timing of warnings, and inadequate organizational communication.

The lack of warning systems for HAZMAT emergencies applies to both fixed-site and transportation accidents. Critics have argued that existing warning systems are not adequate to inform the public to evacuate. For example, few facilities that use dangerous quantities of

HAZMATs have an alert system that could affect off-site populations. The adoption of warning systems is not limited by knowledge alone but by policy and resource availability.

The speed of onset of some HAZMAT emergencies dictates that warnings be issued in short time frames. Critics of evacuation plans for these hazards claim that warning systems are not in place to provide timely information; therefore, evacuations are not feasible. In many locations the ability to evacuate depends on the existing resources and the ability of emergency workers to provide warnings.

Inadequate organizational communications have led to poorly implemented evacuations. Research has indicated that communities play a major role in determining the operational effectiveness of organizations in emergencies. Warning organizations are sometimes unaware of the risks of HAZMATs because of a lack of communication between the HAZMAT incident response team and those who disseminate the warning. In some cases, vendors withhold information on HAZMATs to protect proprietary information on production processes. People may receive a warning, but the information in that warning may not lead them to evacuate or to go to the best location. One reason for this is that people either cannot distinguish meanings of sirens or determine real warnings from false alarms or tests.

c. Social issues

Social factors influence risk perceptions, because people either deny or do not recognize the existence of the hazard. This behavior is due to habitual exposure to the threat or to the rarity of the event. In any event, if the public perceives that an event is not hazardous or cannot cause harm, they are less likely to evacuate when the threat occurs.

d. Organizational issues

Organizational issues include the adequacy of the planning elements, training of evacuation personnel, and technical basis for evacuation. A series of items have been raised about the scope and content of evacuation planning for HAZMAT incidents. They include: a lack of coordination in planning, lack or adequacy of plans, and plans especially for institutional facilities and special populations.

The lack of coordination in planning is associated with whether plans for evacuation have been coordinated with different agencies at each AF base and, if not, if the absence of coordination will lead to ineffective evacuations. Research shows that the lack of coordination in the planning process among evacuation management organizations can create problems that lead to a poorly implemented evacuation. HAZMAT transportation accidents create coordination problems not well-addressed by evacuation plans.

Another major item is lack of plans and the inadequacy of existing plans. It is not known which of these factors could constrain evacuation effectiveness more. Detailed plans are needed to evacuate special populations such as the hearing-impaired or mobility-impaired or institutional populations such as schools, hospitals, nursing homes, or correctional facilities.

The inadequate training of evacuation personnel is an issue that deals with the training for fire department personnel and security police. These emergency personnel support evacuations by performing different tasks (e.g., warning, transport, traffic control, law enforcement, and the like). Better training should improve evacuation planning and execution. Training may be accomplished by organizing existing knowledge into training courses to better prepare all emergency personnel.

The technical basis for evacuation is related to the lack of data or information on which to base the planning. Items associated with this issue include: no organizations for developing plans, poor dissemination of technical knowledge, and lack of knowledge about the population at risk. Technical information used to define risk is inadequate for evacuation planning because no organizations are tasked to develop, disseminate, or apply information. Poor dissemination of technical knowledge is another problem because there is no plan for spreading the available technical information or issuing needed equipment to implement an evacuation plan.

Cost, time, and AF priorities are involved for above considerations. Determining which populations are at risk is a problem during some HAZMAT incidents. Evidence suggests that knowledge of area populations potentially endangered is valuable in developing and implementing an evacuation plan. Emergency responders may not know whom to notify nor the characteristics of the population at risk. Such uncertainties are of particular importance during a HAZMAT transportation accident.

e. Response issues

Response issues in regard to evacuation consist of public behavior and to perception that evacuation is not beneficial to the public. Public behavior deals with the response of people in a way that will jeopardize the effectiveness of evacuation. Items related to this issue include convergence, stress occurring due to evacuation, and people not knowing how to evacuate.

Evacuation "convergence" is the movement of personnel and vehicles into the evacuation area for both official and unofficial reasons. Studies suggest that this convergence occurs in many HAZMAT incidents during both the pre- and postimpact periods and that this behavior interferes with the flow of traffic leaving an evacuation area and causes problems for those who must control access to evacuated areas or direct traffic. In addition, convergence places the population in high risk areas at a greater disadvantage.

Stress due to evacuation is dysfunctional. A number of studies suggest that stress is elevated by emergencies and the levels vary among individuals and among incidents. Some critics suggest that stress is not mitigated because health services are not provided during or after the evacuation experience.

Lacking knowledge on how to evacuate, people may unknowingly put themselves at higher risk or will simply fail to evacuate because they are not informed as to what to do. Research on the behavior of HAZMAT emergency victims who die during evacuation suggests that some people take the wrong route because of inadequate information in poor warning messages.

The issue that evacuation is not perceived as a public good challenges the safety goals of evacuation as a feasible protective action option. The main item in regard to this issue is that evacuations create liabilities. The major problem is that concern about this liability may impede decision making. This issue is extremely complex and has several dimensions. By developing plans, a governmental entity becomes liable for not evacuating people effectively. A second dimension is that decision makers are liable for damages incurred while evacuating. A third is that liability exists for losses from false alarms. A fourth dimension is that liability is incurred for the stress of a bad evacuation experience. The last is that liability arises for failure to develop evacuation plans.

4. Vulnerable Zones and Toxic Plume Models

Garrett stated that vulnerable zone calculations may aid in estimating evacuation zones.* A vulnerable zone is defined as the geographical area in which the airborne concentration of a HAZMAT following an accidental release could reach a critical level (level of concern) in the air that may cause serious immediate health effects to anyone exposed for a short period of time. The area encompassed by this zone depends on the amount of HAZMAT that may become airborne in a release and the level of concern for the HAZMAT released. The EPA provided guidance on how a vulnerable zone around a facility or how a transportation route is to be calculated. It is briefly outlined below:

- a. Determine the quantity of each HAZMAT that could potentially be released per unit of time
- b. Find the level of concern for each HAZMAT
- c. Determine the distance over which the concentration of the HAZMAT could reach or exceed the level of concern

*Garrett, R. L., EPA, personal communication, August 4, 1987.

d. Using the distance as a radius, draw a circle around the site with the location of the potential source of release at the center. (The area within the circle is the vulnerable zone.)

Toxic plume models can also be useful in determining evacuation zones. This type of model estimates the movement, dispersion, and downwind chemical concentrations resulting from a HAZMAT spill. The CAMEO software (References 13 and 14) includes a plume model entitled Aloha which calculates dispersion using Gaussian statistics. Aloha currently has information on only 270 chemicals, but its data file can be added to and modified so that it could consist of 400 HAZMATs. Other toxic plume models exist and a number of them (i.e., the complex hazardous air release model, wind and diffusion over complex terrain model, the dense gas model, and the hypergolic accidental release model) have been evaluated by ICF Incorporated (Reference 18).

5. Decision-Making Criteria for Personnel Evacuation

The following criteria are derived from the detailed information and research of the previous work on evacuation and should be considered before a spill occurs.

a. Warning issues

- (1) Are warning systems available?
- (2) Can the warning systems provide timely information?
- (3) Is there adequate communication between the incident response organizations?
- (4) Is there adequate communication between the HAZMAT incident response team and those who disseminate the warning?
- (5) Have the instructions to be given to the evacuees been developed and are they clear/simple?

b. Social issues

- (1) What were the preemergency risk perceptions of the people to be evacuated?

c. Organizational issues

- (1) Was the planning for evacuation adequate?
 - Was there coordination between base agencies during the planning?
 - Do evacuation plans exist?

- Are the evacuation plans adequate?
- Do plans for the evacuation of institutional facilities and special populations exist?
- Have maps with evacuation routes and alternatives clearly identified been prepared?
- Were agreements with nearby jurisdictions and with hospitals outside of the local jurisdiction to receive evacuees made?

(2) Are the Evacuation Assistance Personnel trained on evacuation procedures?

(3) Has the interface between the fire department, security police, base medical treatment facility, and others been coordinated?

- Response issues

(4) The public might behave in a way that will jeopardize the effectiveness of evacuation

- Convergence
- Stress due to evacuation
- People may not know how to evacuate

(5) Evacuations create liabilities

- The AF is liable for not evacuating people effectively
- The decision makers are liable for damages incurred while evacuating
- Liability exists for losses from false alarms
- Liability is incurred for the stress of a bad evacuation experience

The criteria to consider after a HAZMAT incident has occurred follow:

a. Isolate and deny entry to the hazard area:

(1) Use the criteria in DOT's Emergency Response Guidebook (Reference 2)

(2) Use the guidance from NOAA's CAMEO Response Information Data sheets (References 13 and 14)

b. Consider the nature of and the circumstances surrounding the spilled/released HAZMAT(s):

(1) Determine the amount HAZMAT released

- Size
- Concentration

HAZMAT

(2) Identify the physical and chemical properties of the

- Physical state
 - Solid
 - Liquid
 - Gas
- Odor, color, and visibility
- Flammability
 - Flashpoint
 - Ignition temperature
 - Flammable limits
- Specific gravity
- Vapor density
- Solubility
- Reactivity
- Crucial temperatures
 - Boiling point
 - Freezing point

(3) Determine the dispersion pattern

- Does the release follow the contours of the ground?
- Is the release a plume?

pattern? - Does the release have a circular dispersion

(4) Identify the atmospheric conditions

- Wind
 - Speed
 - Direction
- Temperature
- Moisture
 - Precipitation
 - Humidity
- Air-dispersion conditions
 - Normal
 - Inversion
- Time of day
 - Daylight
 - Darkness

(5) Identify the dispersion medium

- Air
- Land
- Water

(6) Determine the rate of the release of the HAZMAT

(7) Identify the potential duration of the release

c. Consider the effect of the released HAZMAT on people:

exposure (1) Investigate the health hazards from a short-term

- Acute or chronic hazards
- Respiratory hazards

- Skin and eye hazards

- Ingestion hazards

d. Identify the initial area to be evacuated:

(1) Estimate the evacuation area through use of EPA's vulnerable zone equations (Reference 16)

(2) Use the guidance from NOAA's CAMEO response information data sheets (References 13 and 14)

(3) Use the criteria in DOT's Emergency Response Guidebook (Reference 2)

e. Consider the life safety factors:

(1) Identify the types of people that might require evacuation

- How many people will be involved and where are they?

- Where are they located?

- Residences

- Educational institutions

- Medical institutions

- Health care facilities

- Child care facilities

- Correctional facilities

- Offices

- Commercial establishments

- Manufacturing/industrial/research facilities

- Places of public assembly

- Parks and other recreational areas

- Sporting arenas/stadiums

- Roadways

- What is their degree of mobility?

- Persons lacking private transportation
- The elderly
- Children
- Handicapped persons
- The infirm
- Prisoners
- Are there any communication barriers to address?
 - Deaf people
 - Non-English speaking persons
- Who should be evacuated first, second, third, etc.

(2) Determine the resources needed to conduct a safe and effective evacuation

- Personnel
 - Fire department
 - Security police
 - Base medical treatment facility
- Vehicles
 - Lift-equipped buses and taxi cabs for handicapped persons
 - Ambulances for infirm and handicapped persons
 - Vehicles for transporting persons lacking private transportation
- Equipment
 - Personal protective clothing for Evacuation Assistance Personnel
 - Protective clothing for evacuees who may have to be taken through an area of heavy chemical concentration
 - Communication equipment (e.g., portable and mobile radios, mobile public address systems, and bull horns)

ated - Evacuation tags for buildings that have been evacu-

f. Consider the evacuation options:

- (1) No evacuation is required
- (2) The people should be ordered to remain indoors
- (3) The people should be rescued
- (4) A selective evacuation of part of the hazard area is required
- (5) A general evacuation of the entire area should take place

g. Steps to be followed if it is decided that an area is to be evacuated:

- (1) Assign tasks to Evacuation Assistance Personnel
- (2) Inform people that they must evacuate and provide them with accurate instructions

- (3) Provide movement assistance to evacuees

- Arrange transportation for evacuees who are without private transportation

- Arrange for the movement of the infirm and handicapped

- Control the traffic flow

- (4) Direct vehicular traffic out of the evacuated area

(5) Prevent outside traffic from entering the evacuated area

- Encourage evacuees to move along swiftly

h. Provide shelter to the evacuees

i. Make sure that the original estimated evacuation area has not changed

- (1) Periodically recalculate the vulnerable zone with updated data, and/or

(2) Monitor the plume of the released HAZMAT(s) via a toxic plume model

6. Evacuation Decision-Making Checklist

The following list has been prepared as a quick reference for use by on-scene fire department personnel during evacuation from an HAZMAT incident.

a. Isolate and deny entry to the hazard area (Request security police assistance.)

b. Identify the nature of and the circumstances surrounding the spilled/released HAZMAT(s)

- HAZMAT
- (1) Determine the amount of HAZMAT released
 - (2) Identify the physical and chemical properties of the
 - (3) Determine the dispersion pattern
 - (4) Identify the atmospheric conditions
 - (5) Identify the dispersion medium
 - (6) Determine the rate of release of the HAZMAT
 - (7) Identify the potential duration of the release

c. Determine the health hazards from a short-term exposure (Contact the BEE for this information)

d. Identify the initial area to be evacuated

e. Identify the types of people that might require evacuation

f. Determine the resources needed to conduct a safe and effective evacuation

g. Determine the evacuation option

- (1) No evacuation is required
- (2) The people should be ordered to remain indoors
- (3) The people should be rescued
- (4) A selective evacuation of part of the hazard area is required
- (5) A general evacuation of the entire area should take place

G. POSTINCIDENT EVALUATION AND FEEDBACK

1. Evaluation Procedures

This section assumes that the AF will adopt a computerized HMIMS system for managing both HAZMAT inventories and debriefing checklists. It is also assumed that bases will have an Environmental Planning Officer (EPO) who is responsible for environmental compliance, and an Environmental Planning Committee (EPC), chaired by the EPO.

The process of evaluation will be directed by an Incident Review Board (IRB), which shall consist of the Base Commander or his representative (who may be the EPO), the EPO, representatives of all agencies who participated in the incident, and a representative of the user agency. That board will receive and review reports from all of the agencies participating in the response effort. Recommendations and directives of the IRB, although subject to appeal, will be considered binding.

The incident evaluation process is seen as consisting of three parts. First, each organization evaluates itself, starting at the lowest level and working to the highest. Individual workers submit narrative reports to their supervisors, stating what they observed and did. From these reports supervisors check off practical factors performed and qualifications achieved. Workers also include comments about equipment performance or nonperformance, suggestions for procedural improvement, and areas in which they had problems or feel that they need further training. Supervisors write a report stating their own and their group's actions and how response can be improved. Working from incident documentation and individual reports, the manager prepares a narrative description of the agency's actions, with each major action component covered (for example, the fire department would report on the first response unit, FCC, SFO, the team safety officer, the team information officer, the reconnaissance and entry/backup, the team efforts, and so on). Problems, needs, and suggestions are summarized.

A trained evaluator should observe drills and training exercises, receive the reports of the unit evaluated, and append his comments. The suggested source of these evaluators is the Exercise Evaluation Teams provided for in AFR 355-1, 5-4. AFR 355-1, 5-3.b.(2) calls for an annual drill involving "chemical weapons or agents or industrial chemicals." The evaluation checklists proposed here should be used formally in that process and possibly appended to AFR 355-1.

For evaluation considerations for the organization as a whole include whether policy, procedures, equipment, the chosen response, and the amount of response were adequate; whether policies and procedures were followed properly (including operational checklists), whether this result had the intended effects; and whether circumstances beyond agency control impacted the activities. Where negative exceptions are found (e.g., procedures not followed, personnel not able to perform some

activity due to lack of training or equipment, problems caused by failure of other organizations to follow procedures or effectively act), cause should be sought and possible remedial action proposed. The report itself shall consist of a brief narrative of the organization's activities during the incident, problems encountered, causes of the problems, and possible corrections to prevent recurrence. Exceptionally good performance should also be noted. Group and individual narratives used in preparing the report should be appended, along with any documentation collected, so that other evaluators could go back to these early sources.

Second, once the organization's narrative and self-evaluation are completed, a member of the base EPO (or the Exercise Evaluator Team in the case of a drill) and a member of the evaluated organization should go over the report to ensure completeness, clarity, accuracy, and conformity to format. The IRB should then complete the evaluation process.

The third stage of evaluation, IRB evaluation of the incident and the agencies involved, recognizes that the incident and response activities are part of a system. Problems encountered in one part of the system are likely to impact other components of the system. IRB action shall consist not so much of punishing the guilty as of attempting to solve problems. It should integrate the reports of the various agencies involved so that problems can be viewed from a systematic perspective. Any corrective action taken will be integrated with the activities of the other involved agencies. This position is in line with AFR 355-1, 5-10, which states that "exercises should be conducted as no-fault or training-oriented." The IRB will produce a summary narrative, summarize the major problems encountered, and prescribe the action needed to correct those problems. The component organization reports will be appended to the IRB summary, with IRB endorsement or rejection of proposed changes or remedies. IRB will review and revise the SPR and Hazardous Waste Management (HWM) plans, as needed, and will document any revision in its report. A summary of each IRB report of incident evaluation should be sent to a central office in the AF, briefly summarizing the incident, what was done, and lessons learned from the event. Ideally the report should be less than five pages, and contain an address for further information. Important lessons can be passed to appropriate agencies. Evaluation checklists proposed here should be used formally in that process and possibly appended to AFR 355-1.

An important concern in the review process is that it not place too large a burden of administration on the agencies involved. Accordingly, the formality of the process might be allowed to vary with the severity of the incident.

An aggregation of current HAZMAT sources reveals three response levels to all types of HAZMAT incidents. Each level involves response tasks based on the amount of expertise required by the situation and the level of expertise responders are capable of applying to the incident.

Selection of response levels is determined by the seriousness of the incident (size of the spill, the number of personnel required to control the incident, the type of HAZMAT involved, how extensive the threat to life is, and the size and amount of equipment involved). The levels of response are designated Level I, Level II, and Level III and are numbered according to increasing levels of hazard. The NFPA planning guide for determining response level identifies the parameters used in this determination (Table 4).

If an incident is not large enough to warrant a multiagency response, it might be evaluated within each individual agency. For example, for a Level I incident, only the user and fire department would need evaluation. Each would evaluate itself, and, in addition, the user would be evaluated in accordance with normal postfire processes. The user would also be subject to EPA/OSHA/DOT reporting and evaluation processes.

If the incident was not reportable and the agencies concurred, the IRB might never meet, a base report on the incident might be dispensed with, and files on the incident might be minimal and be maintained in the offices of the individual agencies. On the other hand, for a major, reportable incident, the process might need to be fully elaborated. The major consideration in evaluation of reportable incidents is that individuals, groups, and agencies not make change recommendations for trivial purposes, thereby keeping documentation to a minimum.

2. Feedback Process

Once the evaluation process is complete, each agency's IRB representative will review findings of the IRB with the parent agency's commander. The commander will state in writing how policy, procedure, and other interventions will take place and who will participate. This document will be coordinated with action agencies and appended to the incident report. Supervisors of response units will critique the activities of their groups using the written reports prepared for the evaluation process as a basis. Leaders will discuss the impact of the changes on the group and on the individual (e.g., how policy and procedure will be different in the future, what remedial actions the group and individual will take, etc.). These critiques will be logged in individual training records as group or individual incident debriefing, and a statement of compliance will be returned to the agency commander. Changes to agency policy and procedure will be documented and returned to the commander, along with documentation of any other action taken, such as the ordering of required new equipment or scheduling of additional training. When all of the statements of compliance within the agency have been collected, the Base Commander will send a statement of agency compliance to the IRB for appendage to the incident report. Changes in policy and procedures will also be archived as appendices to the incident report. The final step in the process will be review of the incident report by the EPO to ensure that all agency action requirement statements and compliance statements have been

TABLE 4. PLANNING GUIDE FOR DETERMINING INCIDENT LEVELS

Incident conditions	Incident Level I	Incident Level II	Incident Level III
Product identifications	Placard not required; NFPA 0 or 1 all categories; all ORM A, B, C, and D	DOT Placard, NFPA 2 for any categories, PCBs without fire, EPA-regulated waste	Poison A (gas), explosives A/B organic peroxide, flammable solid, wet danger, chlorine/fluorine, anhydrous, ammonia, radioactive material, any NFPA 3 & 4 include special hazards, PCB with fire, DOT inhalation hazard, EPA extremely hazardous, cryogenics
Container size	Small (e.g., pail, drum, cylinder except one ton, package, bag)	Medium (e.g., 1-ton cylinder, portable container, nurse tank, multiple small packages)	Large (e.g., tank car, tank truck, stationary tank, hopper car/truck) multiple medium containers
Fire	None	Yes (no product or container involved)	Yes, container/product involved
Leak severity	None/small leak containable with common absorbents, easily overpacked or stopped)	Cannot be controlled without special equipment	Leak cannot be controlled with special equipment
Life safety	No life threatening situation from materials	Localized area, limited evacuation area	Large area, mass evacuation
Environmental impact (Potential)	Minimal	Moderate	Severe
Container integrity	Not damaged	Damaged, able to contain contents for handling	Catastrophic rupture possible

completed and appended to the report. The EPO will then sign off incident review completion on a preface page of the report, which will contain a statement like: "With the exceptions noted below, all agencies involved in this incident have completed their reviews and critiques of the incident and have taken or scheduled those actions mandated by the Incident Review Board."

3. Checklists

Evaluation criteria for various agencies are listed below and have been converted as much as possible into checklists. Because of the high degree of variability possible between locations and incidents, these criteria are listed in the form of broad task dimensions and requirements. It is anticipated that exceptions from these criteria will be carried to the depth of analysis necessary to get at the cause of exception and disclose possible remedial action. However, contextual variation precludes great depth in any checklist. It is recommended that this set of checklists be used as a starting point at the local level, with modifications to meet local requirements and constraints.

a. Evaluation of user agencies

The user is defined as the agency whose vehicle, conveyance, or facility was involved in the incident or the tenant facility at which the incident occurs. This definition accepts that there may be multiple "user agencies," some, all, or none of whom may have caused, contributed to, or aggravated an incident. These various user agencies are subject to directives of the EPA, OSHA, DOT, other federal agencies, and state and local agencies and their own directives. In recognition of this, the AF has established Environmental Planning Offices and Officers, who are responsible for preparing base HWM and SPR plans. In addition, AF bases are required to maintain a Disaster Preparedness Office and a DPO Plan, which may also entail user compliance.

In consultation with the EPO and legal counsel, the user is to enact policy, procedures, and practices that ensure compliance with a wide variety of directives. Because these directives may vary from state to state and from user to user, only a generic form of evaluation criteria can be offered in this report; final criteria and checklists will have to be developed for each user. The major evaluative criterion for any user is whether it was in compliance with law and regulation and whether an incident resulted from failure to comply with either that body of regulation or with user policy and procedures. Other major criteria include temporary storage facilities (or generators of hazardous waste) whether they are maintained by up-to-date policies and procedures, whether equipment and/or systems performed as expected, whether they are maintained by an up-to-date contingency response plan, whether their HMIS is up-to-date, whether they followed prescribed procedure in cleaning up and/or reporting spills, and whether they effectively aided the responders.

In writing the narrative report and recommendations, some evaluative questions the user should answer include:

- (1) What was the incident?
- (2) Who/what caused the incident?
- (3) Is that cause due to omission or commission of the user?
- (4) Should/could that omission or commission have been prevented through proper adherence to policy or procedures?
- (5) What caused deviation from policy or procedures?
- (6) What steps are needed to prevent recurrence?
- (7) Can it be prevented in the future through new or revised policy or procedures?
- (8) Were the HWM and SPR plans adequate? What changes are needed?
- (9) Are training needs evident for user personnel? What are they?
- (10) Are disciplinary needs evident for user personnel? What are they?
- (11) Are equipment or facility shortcomings evident? What are they?
- (12) What impact will changes have on other organizations on the base and what needs to be done about that?

A specific checklist of items should include up-to-date information on areas:

Did the User:

- (1) conform to EPA requirements? (User should list EPA requirements in checklist form.)
- (2) conform to OSHA requirements? (User should list OSHA requirements in checklist form.)
- (3) conform to DOT requirements? (User should list DOT requirements in checklist form.)
- (4) conform to AF requirements? (User should list AF requirements in checklist form.)

(5) conform to state and local requirements? (User should list state and local requirements in checklist form.)

(6) conform to the HWM plan? (User should list HWM plan requirements in checklist form.)

(7) conform to the SPR plan? (User should list SPR plan requirements in checklist form.)

(8) maintain an up-to-date policy and procedures manual?

(9) conform to policy and procedures?

(10) conform to training requirements for its personnel?

- handling and management
- personnel health and safety
- contingency response actions

Plan? (11) maintain an up-to-date Spill Prevention and Response

(12) conform to Spill Prevention and Response Plan?

(13) maintain up-to-date HMIS with the BEE?

- updated within last 90 days
- materials on inventory were found onsite
- materials on inventory were at mapped locations
- no materials not on inventory were found onsite

(14) clean up known HAZMATs in quantities less than reportable limits defined in local regulations?

(15) recognize and report reportable spills?

(16) assist the base spill response team?

(17) appoint managers for each accumulation point?

(18) use proper containers (e.g., not rusty, damaged, or dented)?

(19) inspect containers weekly and document inspections?

(20) properly post hazards?

- (21) maintain records on accumulation points?
- (22) properly pack and label wastes?
- (23) turn in containers to DRMO within 90 days of starting accumulation?
- (24) properly complete turn-in documents (for a transportation accident)?

Did the permitted storage facility:

- (1) have provisions to prevent unauthorized entry?
- (2) have proper communications equipment?
- (3) store all wastes in DOT-approved containers?
- (4) plan for and perform regular, documented inspections?
- (5) train personnel in facility operation, emergency response and use of emergency equipment, decontamination procedures, documentation and recordkeeping, and personal health and safety?
- (6) maintain training records and permit only properly trained workers to perform job activities?
- (7) maintain adequate fire protection?
- (8) maintain adequate aisle space for emergency response?
- (9) maintain a Contingency Response Plan and emergency response arrangements with appropriate on-base activities?
- (10) meet RCRA requirements for documentation?
 - chronological log
 - file of completed manifests
 - site document file
 - tickler file
- (11) file annual and incident reports to Base Commander?
- (12) track wastes from reception at facility to reception by EPA-permitted treatment facility?
- (13) adhere to facility layout plan?

(14) perform required preventive maintenance on storage facilities?

(15) maintain the facility in a clean and orderly fashion?

b. Evaluation of responding agencies; on-scene commander

Normally, the OSC (Base Commander) will not be called in for a Level I response and perhaps not for a Level II response. The SFO will act as OSC for minor incidents and until relieved by the Commanding Officer or his designee for major incident responses. In either case, these criteria should be applicable for the OSC role, whether it is performed by the SFO or by the designated OSC.

The most important functions of the OSC are communications, command, and control. The OSC must receive and evaluate information and recommendations, choose action alternatives, communicate those alternatives to action agencies, and control the activities that result. At the same time, he must ensure that information routed through him to some other end user gets there, manage public relations through the Public Affairs Officer, coordinate with outside agencies, solve problems as they arise, and untangle organizational disputes. The major task dimensions of the OSC are listed below as a general checklist. They form the basis for evaluative criteria.

Did the OSC:

(1) activate or authorize activation of appropriate members of the spill response team on information relayed during the initial notification and/or information provided after initial investigation of the reported spill?

(2) determine the source, type, extent, and approximate quantity of the spill substance?

(3) evaluate the magnitude and severity of the threat to public health, welfare, and natural resources?

(4) make sure actions were taken to:

- remove and treat medical casualties?
- fight fires?
- evacuate the area?
- establish the cordon?
- shut down utilities?

- monitor for radiation?
 - secure classified materials?
- (5) take appropriate safety precautions to protect response personnel and additional personnel located near the probable spill route (including evacuation or withdrawal, as needed)?
 - (6) determine the party responsible for the spill?
 - (7) determine the cause and institute appropriate action to stop the source of the spill if still occurring?
 - (8) institute spill containment procedures?
 - (9) ensure that all personnel were cognizant of their own and others' responsibilities at all times?
 - (10) maintain a status log detailing which personnel were assigned which roles and responsibilities throughout the incident?
 - (11) ensure orderly turnover of activities from one team of responders to the next?
 - (12) determine whether highly vulnerable areas such as water supplies, regional waste water treatment plants, or recreational waters might be adversely affected and notify appropriate personnel or organizations?
 - (13) assure that the BEE took samples to determine the chemical nature, concentration, and extent of the spill as required for response actions and documentation?
 - (14) determine whether a reportable spill had occurred and notify appropriate federal, regional, state, and AF command environmental coordinators as soon as possible?
 - (15) advise the Base Public Affairs Office of the size and nature of the spill and response action?
 - (16) approve the initial news release to the media?
 - (17) initiate cleanup actions?
 - (18) assure the proper disposal of the spilled HAZMATs and associated contaminated material?
 - (19) ensure that contaminated vehicles remained inside the cordoned area or traveled over sealed routes?

(20) assess the damage caused by the spill and initiate efforts to restore the environment to the prespill condition?

(21) ensure that emergency equipment was restored to full operational status?

(22) investigate the cause of the incident and develop corrective action plans to ensure that the spill or similar spills do not recur?

(23) make an operations event/incident report for all spills classified as "major" or that interfere with the mission of the base?

(24) if incident was off-base, did the OSC:

(25) establish a National Defense Area?

(26) contact civil officials on-scene and coordinate activities?

(27) establish contact with the base to report the situation?

c. Evaluation of responding agencies; fire department

Senior Fire Officer (SFO)/response team leader

The roles of OSC, SFO, and Response Team Leader (RTL) are varied, depending on the level of the response and the number of personnel required to handle the incident. At times, all three roles might be performed by one person, while at other times by all three, or by two persons. The OSC and SFO might be combined or the SFO and RTL. Whatever the case, the responsibilities of each person must be carefully and clearly stated. Evaluative checklists are presented here for the SFO and RTL, recognizing that the roles may be performed by two persons or by only one.

Did the SFO:

(1) respond to the HAZMAT incident?

(2) ensure that the immediate, contaminated area was cleared of all personnel, as necessary, in conjunction with the security police?

(3) evaluate the spill to determine level of response?

(4) determine the number of fire department personnel needed to respond to the incident?

(5) notify CE of incident?

- (6) direct the FCC to notify other agencies as required?
 - (7) update CE on spill, including substance, amount, area covered, location of spill, and spill surface?
 - (8) shut down utilities as required?
 - (9) sandbag storm drains, if needed to prevent spread of spilled materials?
 - (10) implement fire and explosion abatement action?
 - (11) designate the entry control point and relay the coordinates to the fire communications center operator?
 - (12) authorize the distribution of HAZMAT equipment from the HAZMAT response vehicle?
 - (13) make initial determination whether the quantity of the HAZMAT spilled met or exceeded the statutory reportable quantity for that material?
 - (14) function as the OSC until the arrival of the Base Commander or his designated representative?
 - (15) upon arrival of the OSC, brief the status of the incident (i.e., the number of casualties, property damage, and the need for assistance)?
 - (16) provide technical assistance with respect to response to and handling of combustible or flammable substances?
 - (17) provide a liquid fuels maintenance representative to report to the scene to measure explosive vapor concentrations and to determine where explosive hazards exist?
 - (18) ensure return of fire and HAZMAT equipment to normal operating condition?
 - (19) ensure restoration of expendable supplies to proper inventory levels?
 - (20) provide follow-on services to cleanup units?
 - (21) assist in developing a recovery plan, as requested?
- Did the RTL:
- (1) record the nature of the HAZMAT incident?
 - (2) record the location of the HAZMAT spill?

- (3) record the date and time of the HAZMAT emergency?
- (4) assign the following personnel:
 - team information officer?
 - team safety officer?
 - RECON personnel?
 - entry and backup personnel?
 - others (e.g., OSC, security police, BEE)?
- (5) maintain a status log of personnel assigned to specific roles and responsibilities?
- (6) manage the spill site:
 - block and control access to the facility?
 - isolate the hazard area (e.g., evacuate the room, floor, floors above and below, and building/facility)?
 - obtain the isolation distance (hot zone) and the warm and cold zone distances from the information officer?
 - determine whether evacuation was required?
 - designate a staging area for the HAZMAT incident response team?
- (7) identify the HAZMAT:
 - develop an evaluation form on each HAZMAT?
 - obtain MSDSs from the BEE and prefire plans or shipping documents?
 - communicate with the on-scene personnel?
 - contact the manufacturer?
 - identify occupancy/contents of interior exposures?
- (8) assess the hazards and risks:
 - check the integrity of the containers for:
 - thermal stress?

- mechanical stress?
 - corrosive stress?
- (9) evaluate the HAZMATs for:
- health?
 - flammability?
 - reactivity?
 - physical properties?
 - environment?
- (10) reevaluate the hot zone to make sure that it was adequate?
- (11) estimate the likely harm to personnel, property, critical systems, and the environment without intervention?
- (12) evaluate whether further evacuation was necessary?
- (13) meet with the HAZMAT emergency response team to discuss the current status of the incident?
- (14) brief the OSC?
- (15) select protective clothing and equipment:
- obtain the required level of protective clothing (i.e., Level I, II or III; Reference 15) and suggested control agents from the BEE?
- (16) brief the RECON personnel on:
- hazards?
 - assignment?
- (17) obtain permission from the OSC for the RECON operation?
- (18) monitor the communications of the RECON personnel?
- (19) debrief the RECON personnel and retrieve data?
- (20) coordinate information and resources:
- brief the entire HAZMAT incident response team on the current status of the emergency?

- meet with the representatives from other agencies to see if they had the capabilities to handle the incident?

- conduct a meeting of the on-scene personnel to review and discuss tactical options (e.g., defensive and offensive)?

- advise the OSC of the tactical options and recommendations?

- brief all involved personnel on:

- options?

- course of actions?

- responsibilities and roles of each group?

(21) control the HAZMAT spill and stop leaks:

(22) make sure that all HAZMAT incident response personnel were prepared for operations?

(23) brief the entry personnel on:

- hazards?

- assignments?

- emergency signals (i.e., hand and audible)?

- personal protective clothing failure procedures?

(24) obtain permission from the OSC to commence operations?

(25) monitor the communications of the entry personnel?

(26) coordinate with the safety officer during entry operations?

(27) advise the SFO/OSC whenever the safety of response personnel was in question?

(28) establish a schedule for rotating entry and backup personnel?

(29) terminate the HAZMAT incident response activities:

- collect all hard data on the HAZMAT emergency?

- debrief all personnel on the incident?

- ensure that all personnel were aware of possible signs and symptoms of exposure to the HAZMAT?

- establish requirements for further medical monitoring?

- ensure return of equipment to normal operating condition?

- ensure return of expendables to normal inventory levels?

Team safety officer

The team safety officer is the person who most closely directs and supervises fire protection response efforts in containment and control of a HAZMAT incident. After the RTL, he is the one who is most technically proficient and knowledgeable about HAZMAT chemistry, protective equipment, control and mitigation techniques, and identification methods. Similarities in the RTL and safety checklists reflect similarities in their roles. The team safety officer checklist follows.

Did the team safety officer:

- (1) record the nature of the HAZMAT incident?
- (2) record the location of the HAZMAT spill?
- (3) record the date and time of the HAZMAT emergency?
- (4) evaluate the positioning of the response team personnel and apparatus?
- (5) obtain zone distances from the information officer?
- (6) establish the hot and warm zones?
- (7) communicate zone locations to the HAZMAT incident response team leader?
- (8) determine whether the command post was in a safe location?
- (9) determine whether the staging area was in a safe location?
- (10) designate the initial entry control point location?
- (11) determine whether the entry and backup personnel were in the proper protective clothing?

(12) inspect the personal protective clothing for:

- imperfect seams?
- nonuniform coatings?
- tears?
- malfunctioning closures?
- pinholes?
- cracks?
- shelf deterioration?
- chemical attack (i.e., discoloration, swelling, stiffness, and softening)?
- punctures?

(13) inspect FES for:

- operation of the pressure relief valves?
- fitting around wrists, ankles, and neck?
- crack, crazing, and fogginess of the face shield?

(14) inspect respirators for:

- tightness of all connections?
- signs of pliability, deterioration, and distortion?
- proper fitting?
- operation of regulators and valves?
- operation of alarm(s)?
- cracking, crazing, and fogginess of the face shields and lenses?

(15) ensure that the entry team checklist was being followed and completed?

(16) make sure that the hazard and procedures briefing was completed by the HAZMAT incident response team leader?

(17) ensure that entry operations were being coordinated with DECON personnel?

(18) make sure that emergency warning signals were known by all HAZMAT incident response team personnel?

(19) make sure that the signs and symptoms of chemical exposure and heat stress were communicated to all involved personnel?

(20) restrict entry into the hot zone to HAZMAT trained personnel and individuals possessing particular knowledge of the problem/situation?

(21) monitor the entry personnel for signs/symptoms of chemical exposure and heat stress?

(22) remain in constant contact with the team leader and entry personnel?

(23) remove and treat medical casualties?

(24) perform firefighting and/or rescue operations?

(25) stabilize, control, and contain the spill/release of the HAZMAT?

(26) halt operations and order personnel back to the warm zone if unsafe conditions were observed?

Team information officer

The team information officer is the primary link between the response scene and the outside world. His responsibilities include serving as a two-way information conduit relaying operational messages and an information source, using data bases and other data sources to aid in HAZMAT identification and response planning. In addition, he serves as a technical consultant, looking up various prescribed actions and advising command personnel concerning recommended actions. An evaluative checklist follows.

Did the team information officer:

- (1) establish and maintain communications with the FCC?
- (2) determine the nature of the HAZMAT incident?
- (3) determine the location of the HAZMAT spill?
- (4) determine the date and time of the HAZMAT emergency?
- (5) identify the contents of all exposed containers?
- (6) consult at least three of the following information

sources:

- HAZMAT Information System (HMIS)* (DOD)?
 - Emergency Response Guidebook (DOT)? (Reference 2).
 - Hazardous Chemical Data Manual for the Chemical Hazards Response Information System (Coast Guard)? (Reference 6).
 - Pocket Guide to Chemical Hazards (NIOSH)? (Reference 7).
 - Fire Protection Guide on HAZMATs (NFPA)? (Reference 9).
 - Emergency Handling of HAZMATs in Surface Transportation (American Association of Railroads)? (Reference 8).
 - Acutely Toxic List (EPA)? (Reference 10).
 - Oil and HAZMAT Technical Assistance Data System (OHM-TADS) (EPA)?**
 - Dangerous Properties of Industrial Materials (Reference 11)
 - MSDSs?
 - Shipping documents?
 - Chemical Transportation Emergency Center (CHEMTREC)?**
 - HAZMAT manufacturer?
- (7) evaluate the HAZMATs for:
- health?
 - flammability?
 - reactivity?
 - corrosivity?
 - radioactivity?

*See footnote in Section IIB4.

**See footnote in Section IID1.

- physical properties?
 - chemical properties?
- (8) determine the isolation (hot and warm zones) and evacuation distances and communicate the information to the HAZMAT incident RTL?
- (9) record the weather information:
- current conditions?
 - forecast conditions?
- (10) record the location of the DECON area?
- (11) collect data from the RECON personnel:
- checklist?
 - site drawings?
 - photographs?
- (12) relay information, messages, and requests for assistance between OSC and outside agencies?
- (13) when response to the emergency was terminated, gather the checklists and notes from the HAZMAT incident team members?

Fire response unit

The fire response unit is usually the fire department crew, responding to either a fire or a HAZMAT call. Often, this team has no information about the presence of a HAZMAT or even may have incorrect information. The major criteria for the first response unit are whether they approached the incident properly, whether they made a correct initial determination, and whether they responded appropriately to that diagnosis. An evaluative checklist follows:

Did the first responding unit:

- (1) assess the fire site for HAZMAT?
- (2) access the HMIS inventory?
 - quickly without needing to consult instructions?
 - without false starts?
 - incorrect location?

- (3) correctly interpret the inventory?
- (4) use inventory information for diagnosis?
 - sole source?
 - confirmatory or disconfirmatory?
 - primary source, confirmed by field observation?
- (5) communicate exceptions to the inventory to the BEE?
- (6) alert and activate the response system?
- (7) communicate the information:
 - correct chemicals?
 - correct locations?
 - correct additional necessary information to the right persons?
- (8) properly prescribe and conduct evacuation?
- (9) properly isolate the site and control access?
- (10) carry out confirmatory identification of the HAZMAT?
- (11) perform adequate risk assessment?
- (12) monitor personnel for signs and symptoms of exposure?
- (13) properly perform basic containment and control?
 - Was it carried out?
 - Should it have been carried out?
 - Was the proper procedure chosen?
 - Was it carried out adequately?
- (14) return equipment to normal operating condition?
- (15) return expendables to normal inventory levels?

RECON team leader

Did the reconnaissance team:

- (1) record the nature of the HAZMAT incident?

- (2) record the location of the HAZMAT spill?
- (3) record the date and time of the HAZMAT emergency?
- (4) perform communications check?
- (5) obtain the required resources for RECON:
 - binoculars?
 - monitoring instruments?
 - camera?
 - prefire plan?
 - clipboard and pencil?
 - utility maps?
 - storm/sewer maps?
 - RECON checklist?
- to RECON? (6) coordinate with the HAZMAT response team leader prior
- officer? (7) coordinate all data gathering with the information
- situation and about the procedures to be followed? (8) brief RECON personnel on what was known about the
- (9) obtain the following information:
 - HAZMAT containers?
 - type
 - number
 - condition
 - exposures to
 - life
 - property
 - environmental

- other related HAZMAT
- storm/sewer drains?
- topography?
- access/egress routes?
- wind direction and speed?
- ignition sources?
- water supplies?
- type of heavy equipment in the area?
- utilities?
- vehicles in the area and their contents?

(10) make every attempt to view the incident from all sides?

(11) avoid the hot zone unless specifically approved by the HAZMAT incident response team leader?

(12) develop the incident site plan?

Entry backup team

For positions higher in the response hierarchy, a major portion of the responder's tasking has been cognitive- and judgment-oriented; that is, of a decision-making, action-planning, and supervisory nature. At the hierarchical level of the entry team, the major component is not directing but doing. The primary criterion for the entry team is how well it performed the tasks prescribed for it. A checklist for evaluation follows:

Did entry personnel:

- (1) don the proper protective clothing, using the suit-up checklist for that equipment?
- (2) using prescribed procedures, enter the hot zone?
- (3) identify the HAZMAT?
- (4) accurately size up the situation?
- (5) relay information to the HAZMAT incident response team leader?

- (6) rescue as the situation dictated?
- (7) make suggestions on the stabilization, control, and containment of the hazard?
- (8) stabilize, control, and contain the spill/release of the HAZMAT?
- (9) if there was a fire, extinguish it?
- (10) evaluate actions for effectiveness and for termination?
- (11) return equipment to operating condition?
- (12) return expendables to normal inventory levels?

Did backup personnel:

- (13) don the proper protective clothing, using the suit-up checklist for that equipment?
- (14) prepare to rescue the entry personnel?
- (15) assist and relieve the entry personnel?
- (16) furnish additional equipment and/or supplies to the entry personnel?

Fire communications center operator

The FCCO is the primary link between the response team and the fire department and is one of two major operational communications links used by the Information Officer in seeking assistance and passing information. Evaluative criteria include:

Did the Fire Communications Center Operator:

- (1) record what the problem was?
- (2) record where the problem was located?
- (3) ask what HAZMAT was involved?
- (4) ask what form the HAZMAT was in:
 - solid?
 - liquid?
 - gas?

seen? (5) ask whether any vapor clouds, fumes, or spills were

(6) determine the wind direction and speed?

(7) plot the incident on a map?

(8) dispatch fire department equipment and personnel to the HAZMAT emergency site?

(9) provide the SFO with the information acquired in the steps above?

(10) plan the route of approach for the HAZMAT incident response team, from the upwind direction, and pass it on to the SFO?

(11) request the spill discoverer to direct and aid the HAZMAT incident response team?

(12) contact other agencies as directed by the SFO?

(13) obtain the on-scene control point location from the SFO, plot it, and relay its location to other responding organizations?

(14) if off-base incident, contact civil agencies as directed?

(15) ensure that CHEMTREC has been contacted by the OSC?

(16) establish links with other remote data bases and sources as requested?

(17) relay messages and information between on-scene and off-scene agencies as requested?

d. Evaluation of responding agencies; bioenvironmental engineering

The BEE is the most knowledgeable individual on the response team with respect to the sampling, identification, chemistry, and mitigation of HAZMAT. He is also the most knowledgeable about the medical impacts of HAZMAT. He is tasked with determining exposure limits, the required response, the required DECON procedure, the required protective clothing, and the required protective health measures for an incident response. How well the BEE performs these functions is the criterion by which he is evaluated.

Did the BEE:

(1) report to the OSC?

(2) check monitoring/sampling equipment operation?

- (3) perform air, liquid, and solid sampling as needed?
- (4) perform chemical analyses or send samples out for chemical analyses, as appropriate, to identify HAZMAT or determine continued HAZMAT presence?
- (5) confirm identification of the HAZMAT?
- (6) provide technical assistance and advice to the OSC and the hospital with respect to the:
 - allowable short- and long-term exposure limits associated with the HAZMATs?
 - applicable environmental quality standards/criteria?
 - required response level?
 - required protective clothing?
 - decontamination protocols?
 - containment/control/mitigation measures?
 - environmental factors to consider during rescue?
- (7) advise the OSC on protective health measures for the response personnel and for the general public?
- (8) conduct continuous air sampling and monitoring during cleanup operations?
- (9) assist the OSC in assessing the efficacy of response efforts?
- (10) ensure that proper respiratory equipment was worn during the response?
- (11) ensure that equipment was returned to normal operating condition?
- (12) ensure expendables were returned to normal inventory levels?
- (13) participate in the incident review process?

e. Evaluation of responding agencies; civil engineering

Civil Engineering (CE) is tasked with containment and control operations in a HAZMAT incident; in fact, even though treated separately in this document, the fire department is part of this organization. The portion of CE dealt with here is the nonfire department portion,

consisting of the BCE, CE service call, and a containment response team. The function of the latter team varies from base to base, but is usually assisting the fire department entry team in containment operations during the incident (e.g., providing heavy equipment and operators) and of performing some mopping up and containment maintenance operations after the incident. The evaluative criteria for CE are listed below.

Civil engineer

Did the civil engineer:

- (1) provide a CE response force with trained personnel, materials, and equipment to assist with containment, cleanup, restoration, and repair?
- (2) approve supply and equipment requests relative to the response?
- (3) identify the utility cutoff points and inform the OSC on the status of affected utilities and facilities?
- (4) keep the OSC advised on hazardous pollutants, oil spills, and toxic chemical response actions?
- (5) direct containment, cleanup, restoration, and repair operations after emergency response teams disengaged?
- (6) assess damage to government property?
- (7) prepare necessary incident reports?
- (8) ensure that all equipment was returned to operating condition?
- (9) ensure that expendables were returned to normal inventory levels?
- (10) participate in the incident review process?

CE service call

Did CE service call:

- (1) contact all response agencies on request of the fire department?
- (2) notify affected personnel of evacuation, as directed by SFO or OSC?
- (3) identify affected utilities and facilities?

(4) obtain and maintain the status of CE crews, equipment, and vehicles?

(5) place the CE Emergency Response Crew on emergency standby status?

(6) dispatch and control response crews requested by the CE?

(7) coordinate CE unit activities at the request of CE?

(8) request supplies and equipment at request of CE?

(9) document CE activities?

Containment response team

Did the containment response team:

(1) don protective clothing?

(2) conduct containment and countermeasures?

(3) conduct cleanup and disposal operations?

(4) return equipment to normal operating condition?

(5) return expendables to normal inventory levels?

(6) file a spill incident checklist?

f. Evaluation of responding agencies; Base Security Police

The major functions of base security police in an on-station HAZMAT response include:

Did Base Security Police:

(1) properly observe base facilities for spills or potential spills?

(2) notify the fire department of the incident?

(3) supervise all security measures at the spill scene?

(4) establish the Entry Control Point and exclusion areas as directed by the SFO?

(5) notify personnel in the evacuation areas as directed?

(6) coordinate and assist in carrying out the evacuation?

- (7) successfully exclude personnel from the site?
- (8) exclude personnel from the evacuation area (including lawbreakers)?
- (9) relocate the entry control point or reduce the cordon size, if requested by OSC?
- (10) prepare the required Incident/Complaint form?
- (11) provide information to OSC regarding security matters which was timely and accurate?
- (12) increase security vigilance at nonaffected secured areas?

In an off-station incident, did Base Security Police:

- (13) brief convoy drivers on road procedures?
- (14) assign a security vehicle to lead the convoy?
- (15) contact base security on arrival?
- (16) contact civil law enforcement agencies for information and assistance?
- (17) advise civil law enforcement agencies on the need to cordon and evacuate?
- (18) notify base security of the entry control point location?
- (19) establish a National Defense Area, if required?
- (20) use Personnel Reliability Program certified personnel to guard nuclear weapons or components?

g. Evaluation of responding agencies; Base Medical Facility

The major functions of the Base Medical Facility are listed.

Did Base Medical Facility:

- (1) provide an estimate of the source strength for toxic chemical spills?
- (2) provide information of expected symptoms and signs of exposure to the suspected or identified chemical(s), as well as confirmatory or disconfirmatory observations of patients under medical care?

- (3) maintain close contact with the BEE?
- (4) provide ambulance service?
- (5) adequate number of ambulances and crews?
- (6) inform OSC of casualty evacuation route for contamination control purposes?
- (7) receive rescued personnel and provide triage and medical actions following procedures as prescribed?
- (8) on-scene personnel advise hospital of additional assistance required and expected casualty load?
- (9) provide the OSC with current and follow-up information on injured personnel as soon as possible?
- (10) prepare a medical recovery plan, if needed?
- (11) provide the casualty reporting officer with the names of identified fatalities?
- (12) return equipment to operating condition?
- (13) return expendables to normal inventory levels?

h. Evaluation of responding agencies: transportation squadron

The major function of the transportation squadron is to provide the vehicles needed by the response crews. The users are expected to provide the drivers.

Did transportation squadron:

- (1) have the needed vehicles
 - available?
 - kept in good repair?
 - returned to normal operating condition?
- (2) provide a qualified operator, if response agency was unable to do so.

i. Evaluation of responding agencies; weather squadron

The weather squadron is very important to a successful emergency response and cleanup effort. OSC needs to know what weather conditions will influence or impact at the site response efforts. In particular, OSC needs to know what the present weather is and what to

expect. For example, if an entry point is set up just before a frontal passage then that point must be relocated when the front passes, and a new area will have to be evacuated. Weather should be evaluated on the following criteria:

Did weather personnel:

- (1) provide the OSC with current weather observations upon notification of the incident and at regular intervals?
- (2) provide OSC with short-term and long-range forecasts on request?
- (3) take a special observation upon notification of a HAZMAT incident and as requested thereafter?
- (4) keep OSC advised of winds at the surface and aloft?
- (5) calculate dispersion and downwind concentrations of airborne contaminants (or, if a plume-modeling program was used by OSC, provide the data needed for those calculations)?
- (6) advise OSC of expected or observed precipitation?
- (7) advise OSC of expected or observed wind shifts ?
- (8) advise OSC of expected or observed frontal passage?
- (9) provide other requested meteorological data as requested?
- (10) advise OSC of expected extremes of temperature, humidity, or wind?
- (11) advise OSC of expected inversion?
- (12) provide estimates of time until occurrence of important weather elements?

j. Evaluation of responding agencies; disaster preparedness office

The DPO will, upon request from the OSC, provide a representative to the site of the spill.

Did DPO:

- (1) ensure that spill response and disaster response activities were coordinated between on-base and off-base agencies (if both plans were implemented)?

- ensure that the Disaster Preparedness Plan was adequate to handle the circumstances of the incident?

-- examine how well did the drill prepared by DPO simulate reality?

k. Evaluation of responding agencies; public affairs office

The primary functions of the Public Affairs Officer are to act as a liaison between the public and base officials and to manage the impression an incident gives the public. Evaluation items are listed:

Did public affairs office:

- (1) respond to the incident?
- (2) keep informed about the progress of the incident?
- (3) clear news releases through the Base Commander or the OSC?
- (4) coordinate news releases with the EPA Regional Response Team's Regional News Office?
- (5) report events accurately?
- (6) anticipate the questions the public and press asked?
- (7) gather the needed information before it was asked for?
- (8) use knowledge of what the press and public would likely want to know to help the OSC in the process of impression management?
- (9) notify the OSC of actions taken?
- (10) set up a news center?
- (11) escort news media to the accident scene, with the approval of the OSC?
- (12) handle news media requests for photographing the site in accordance with AF Regulation 190-1?

l. Evaluation of responding agencies; base services officer

The base services officer is given several taskings in support of a HAZMAT response.

Did base services:

- (1) provide the following items in needed quantities and in a timely manner?

- food
 - equipment
 - supplies
 - laundry services
- (2) issue stores from commissary and exchange as needed?
 - (3) provide search and recovery of human remains?
 - (4) support and advise OSC on search and recovery operations?
 - (5) follow proper procedures in laundering and disposing of contaminated materials?
 - (6) provide mortuary services in accordance with procedures and policy?
 - (7) contact county or state coroner for release and approval to remove remains of AF personnel?
 - (8) coordinate with medical personnel for identification of remains?
 - (9) coordinate with BEE for handling of contaminated remains?
 - (10) notify Casualty Officer of names of identified fatalities?
 - (11) request assistance of Air Force Identification Team (if needed)?
 - (12) return equipment and facilities to normal operating condition?
 - (13) return expendables to normal inventory levels?

m. Decontamination officer team

The proper performance of the decontamination tasks is vital to the health and well-being of all of the personnel involved in the response, as well as that of persons outside the immediate response scene. Unchecked contamination carried from the response area will have detrimental effects on response personnel and on anyone who comes into contact with the contaminants carried from the response area. Evaluative criteria are listed below for both the DECON officer and the DECON TEAM.

Did the decontamination officer:

- (1) prepare for DECON:
 - identify the type and amount of HAZMAT?
- (2) determine how contact with the HAZMAT might be made:
 - contact through the air?
 - being splashed?
 - walking through liquids or contaminated soil?
 - using contaminated equipment?
- (3) determine the health hazards and risks involved with the HAZMATS?
- (4) determine the effects of the HAZMAT on equipment
 - corrosion
 - decomposition
 - degradation
- (5) determine whether the HAZMAT was reactive with water and other substances?
- (6) confer with other specialists concerning DECON?
- (7) identify which was the most acceptable method of DECON?
 - dilution
 - absorption
 - chemical degradation
 - disposal and isolation
- (8) determine the correct DECON protocol to be followed for hazard Levels II and III.
 - maximum DECON protocol for Level III (encapsulating) personal protective clothing?
 - maximum DECON protocol for Level II (nonencapsulating) personal protective clothing?

- minimum DECON protocol for Level III personal protective clothing?

- minimum DECON protocol for Level II personal protective clothing?

- nine-step DECON protocol?

(9) determine what type of neutralizing agents were required and in what quantities?

- Sodium hypochlorite

- Sodium hydroxide

- Sodium carbonate slurry

- Calcium oxide slurry

- Liquid detergents

- Ethyl alcohol

- Trisodium phosphate

(10) determine which DECON solutions were required?

phosphate

- 5 percent Sodium carbonate and 5 percent sodium

- 10 percent Calcium hypochlorite

- 5 percent Sodium phosphate

- Diluted hydrochloric acid

- Concentrated detergent

(11) identify what the symptoms are for an acute exposure to the HAZMAT and pass this information on to all personnel?

(12) determine what the hot, warm, and cold zones were and make sure that they were properly identified?

(13) determine where the entry and exit check points were and make sure that they were properly identified?

(14) determine how much of the DECON must be done by the HAZMAT incident response team and how much can be done by a cleanup contractor or the agency responsible for the spill?

was: (15) make sure that a DECON site was established and that it

- in the warm zone?
- upwind, uphill, and upstream?
- accessible to roads and water?
- free of physical hazards?
- not susceptible to harming the environment?
- properly marked and roped off?

(16) determine whether the DECON site should be located on soil or hard surface?

(17) determine whether DECON could be conducted safely?

(18) make sure there was enough plastic to cover the entire DECON site?

(19) determine which DECON stations were required?

- equipment drop in hot zone
- boot cover and glove wash
- boot cover and glove rinse
- tape removal
- boot cover removal
- outer glove removal
- suit/safety boot wash
- suit/safety boot rinse
- tank change
- safety boot removal
- suit removal
- SCBA tank removal
- inner glove wash
- inner glove rinse

- facepiece removal
- inner glove removal
- inner clothing removal
- field wash
- redress
- medical checkup, fluid replenishment, and rest

(20) make sure that the DECON corridor was set up in a straight line?

(21) make sure that the DECON stations were at least three feet apart and had DECON procedure signs that could be read by personnel in personal protective clothing?

(22) determine the closest hospital that could treat this type of emergency and make sure they were contacted?

(23) determine what local permanent buildings could be used for DECON?

(24) make sure that there was adequate shelter to protect personnel against the environment?

(25) make sure that there were enough of the listed equipment to meet the DECON requirements:

- long-handled brushes
- short bristle scrub brushes
- galvanized wash tubs
- buckets
- plastic trash cans
- plastic bags
- plastic sheathing
- wading pools
- disposable towels
- tables
- chairs or stools

- slippers and clean clothes
- surgical soap, brushes, and sponges
- personnel showers
- SCBA
- disposable drums
- beverages
- weather-appropriate clothing

(26) determine whether plastic bags would contain the contamination?

(27) determine whether the contamination would affect rubber?

(28) ensure that the emergency shower and eyewash had been set up and that they were functioning properly?

(29) ensure that water runoff would not affect any water source during the emergency?

(30) determine type of exposure and HAZMAT?

(31) determine whether any type of medication was required on-site for emergency treatment and ensure availability?

(32) ensure that the base medical facility staff was set up to handle contaminated patients (i.e., protection for them and their ambulance)?

(33) ensure that baseline physicals were available for entry, back-up, and DECON personnel?

(34) make sure that information sheets that provide appropriate guidance on the HAZMATs were prepared and ready to go with contaminated or suspected contaminated patients to the hospital?

(35) make sure that a chart is posted giving the symptoms and first aid procedures for heat rash, heat cramps, heat exhaustion, heat stroke, frostbite, and hypothermia?

(36) make sure that none of the DECON personnel had any open wounds and/or had taken alcohol or medicine (and what kind) recently?

(37) make sure that a transportation vehicle was available if the DECON area was more than 100 yards from the work area in the hot zone?

(38) ensure that plastic was draped over the transportation vehicle and that respiratory protection was available for the driver?

(39) ensure that DECON personnel used and completed the appropriate checklist?

(40) during DECON make sure that:

- DECON and entry personnel had been briefed on which protocol would be used?

- the DECON protocol was being properly followed?

- heart rate, blood pressure, and body temperature and weight were being taken on personnel who were wearing personal protective clothing?

- personnel were being observed for indicators of toxic exposure:

- changes in complexion or skin discoloration?

- lack of coordination?

- changes in demeanor?

- excessive salivation or pupillary response?

- changes in speech pattern?

- inquiries were being made on other indicators of toxic exposure:

- headaches?

- dizziness?

- blurred vision?

- cramps?

- irritation of the eyes, skin, or respiratory tract?

- fingers, toes, and ears were being checked on personnel coming through DECON when the temperature was cold?

- personnel were monitored for heat stress when the temperature was above 80°F?

- monitoring for contaminants at the DECON site was being done?

- swipe tests were being done on the skin of all personnel and on all protective clothing and equipment?

- contaminated tools and equipment and wooden and leather items were being kept in the hot zone?

- during incidents which that require chemical degradation, the mixing and application of chemicals was being performed correctly?

- none of the DECON personnel were eating, drinking, chewing gum, or smoking in the DECON area?

- windows in the transportation vehicle were being kept closed when in the hot zone?

- all personnel took showers with emphasis on cleansing of areas such as the head, groin, and ears?

- all personnel departing DECON received a medical evaluation?

- pieces of protective equipment were being wrapped separately after use to reduce the spread of contamination?

- overspray and splashing were minimized during DECON and water runoff was being diverted to a safe area?

- during vehicle DECON, wheel wells and chassis were cleaned thoroughly and air filters were changed onsite and disposed of properly?

(41) after the HAZMAT emergency was over, ensure that:

- the HAZMAT was isolated, bagged, and placed inside plastic containers?

- all other disposables were properly placed inside overdrums?

- all containers were isolated from each other?

- all pieces of equipment owned by the AF were properly cleaned?

- if clothing was to go out for laundering, the bags were taped closed?

- all personnel equipment was sanitized and sent to maintenance for inspection?

protective clothing? - permeation tests were conducted on the personal protective clothing?

pressure test? - all fire hose was decontaminated and tagged for pressure test?

- all appropriate documentation was completed?

- equipment was returned to operating condition?

levels? - expendables were returned to normal inventory levels?

(42) For maximum DECON protocol for Level III personal protective clothing (Reference 15) did decontamination group personnel:

- deposit equipment used on site onto plastic drop cloths or in different containers with plastic liners?

- scrub outer boot covers and gloves with DECON solution or detergent and water?

- rinse the DECON solution from the outer boot covers and gloves, using copious amounts of water?

- remove tape from around boots and gloves and deposit in container with plastic liner?

plastic liner? - remove boot covers and deposit in container with plastic liner?

plastic liner? - remove outer gloves and deposit in container with plastic liner?

- wash encapsulating suits and boots, using scrub brush and DECON solution or detergent and water?

- rinse the DECON solution from the encapsulating suits and boots using water?

plastic liner? - remove safety boots and deposit in container with plastic liner?

- remove FES and lay it on a drop cloth or hang it up?

- remove hard hat?

- remove self-contained breathing apparatus (SCBA) backpack and place it on a table?

- disconnect the SCBA hose from the regulator valve.

- wash inner gloves with DECON solution that will not harm the skin?
- rinse the DECON solution from the inner gloves using water?
- remove facepiece and deposit it in container with liner?
- remove inner gloves and deposit in container with liner?
- remove inner clothing and place in lined container?
- shower if highly toxic, skin-corrosive, or skin-absorbable materials were known or suspected to be present?
- put on clean clothes?

(43) For maximum DECON protocol for Level II personal protective clothing (Reference 15) did decontamination group personnel:

- deposit equipment used on site onto plastic drop cloths or in different containers with plastic liners?
- scrub outer boot covers and gloves with DECON solution or detergent and water?
- rinse off the DECON solution from the outer boot covers and gloves, using copious amounts of water?
- remove tape from around boots and gloves and deposit in container with plastic liner?
- remove boot covers and deposit in container with plastic liner?
- remove outer gloves and deposit in container with plastic liner?
- wash chemical-resistant splash suit, SCBA, gloves, safety boots, and backpack assembly using scrub brush and DECON solution or detergent and water?
- rinse the DECON solution from the chemical-resistant splash suit, SCBA, gloves, safety boots, and backpack assembly using water?
- remove safety boots and deposit in container with plastic liner?
- remove SCBA backpack and place it on a table?

- disconnect the SCBA hose from the regulator valve?
- remove splash suit and deposit in container with plastic container?
- wash inner gloves with DECON solution that would not harm the skin?
- rinse off the DECON solution from the inner gloves using water?
- remove facepiece and deposit it in container with liner?
- remove inner gloves and deposit in container with liner?
- remove inner clothing and place in lined container?
- shower if highly toxic, skin-corrosive, or skin-absorbable materials were known or suspected to be present?
- put on clean clothes?

(44) For minimum DECON protocol for Level III personal protective clothing (Reference 15) did decontamination group personnel:

- deposit equipment used onto site on plastic drop cloths or in different containers with plastic liners?
- scrub outer boots, outer gloves, and FES with DECON solution or detergent and water?
- rinse the DECON solution from the outer boots, outer gloves, and FES, using copious amounts of water?
- remove outer boots and gloves and deposit in container with plastic liner?
- remove FES and inner gloves and deposit in container with plastic liner?
- remove SCBA backpack and face piece and deposit on plastic sheets?
- wash hands and face thoroughly?

(45) For minimum DECON protocol for Level II personal protective clothing (Reference 15) did decontamination group personnel:

- deposit equipment used on site on plastic drop cloths or in different containers with plastic liners?

- scrub outer boots, outer gloves, and chemical-resistant splash suit with DECON solution or detergent and water?

- rinse the DECON solution from the outer boots, outer gloves, and chemical-resistant splash suit, using copious amounts of water?

- remove outer boots and gloves and deposit in container with plastic liner?

- remove FES and inner gloves and deposit in container with plastic liner?

- remove SCBA backpack and face piece and deposit on plastic sheets?

- wash hands and face thoroughly?

- For nine-step DECON protocol:

- drop tools dirty side down before re-entry?

- enter the DECON area?

- step into wash tub #1?

- confirm that all personnel are well and have an air supply?

- examine suit for breaches?

- scrub down contaminated personnel?

- open suit and disconnect breathing tube, instructing personnel to hold their breath?

- insert breathing tube into the regulator and insert the regulator into facepiece, instructing personnel to exhale while making the connection?

- if positive pressure breathing supply was not required, remove the SCBA?

- leave the facepiece in place?

- remove the SCBA harness and place it on a plastic sheet down on the dirty side?

- remove all duct tape from the facepiece, hood, gloves, and boots?

- place tape in disposal container?

- unzip protective clothing and turn inside out over gloves (if possible)?

- instruct personnel to stand still with arms apart?

- undress the worker without his assistance to avoid contaminating him?

- instruct personnel to step out of inner boots?

- place contaminated clothing inside out in disposal container?

- exercise one of three options:

- instruct personnel to shower and launder clothing?

- transport the personnel by vehicle to a fixed facility for supervised DECON?

- clean personnel on site inside the warm zone?

- instruct personnel to remove undergarments and to soap and shower using personal cleaning kits?

- dispose of cleaning materials inside plastic bags?

- instruct personnel to dry off?

- clean all areas?

- dispose of all drying materials inside plastic bags and plastic bags inside plastic drums?

- don disposable coveralls?

- wrap injured personnel in sheet and blanket and place on backboard?

n. Generic evaluative questions

Whether or not a generic checklist was completed is not an adequate basis for evaluation. A number of generic questions can be asked of each individual, workgroup, or organization that performs a role in the response. These are listed below.

- What actions were required of the individual/group/organization?

- Were those actions which were required performed adequately?

- Were they timely?
- What performance errors were noted?
- What training needs became apparent?
- What problems in policy and procedure, in equipment, and in communication were encountered?
- How were those problems solved?
- If they could not be solved, how could these problems be prevented or solved in the future?

4. Formalization of the Review and Feedback Process

The review and feedback processes should be formalized in AF regulations, as well as in each base's SPR and HWM plans. Specific procedures for these processes should then be incorporated into each organization's policies and procedures guidelines.

H. BIOENVIRONMENTAL ENGINEERING/MEDICAL RESPONSIBILITIES ASSOCIATED WITH HAZMAT INCIDENTS

1. Overview

The Aerospace Medicine Program (AMP), as described in AFR 161-33, is organized to promote and maintain the physical and mental health and well being of all for whom the AF is responsible. The program includes: flight medicine, environmental health (occupational medicine), and bioenvironmental engineering. It applies to all AF installations and activities. The AMP is managed and administered by the Surgeon General through the Aerospace Medical Consultants Division of the Directorate of Professional Affairs and Quality Assurance, headquarters USAF. The organizational elements of the program are:

- (a) Flight or missile medicine provides care for flyers, missile crews, and others with special standards of medical qualification; provides comprehensive medical support services for all aerospace organizations; and ensures a vital and fit military organization by completing proper physical examinations and applying the proper standards on a timely basis for all AF personnel.
- (b) Environmental health provides comprehensive preventive medical services through occupational medicine, environmental health, and public health programs.
- (c) Bioenvironmental engineering conducts programs for the comprehensive surveillance of community and workplace environments.

Components of each of these organizational units are brought to bear on HAZMAT incidents. The more productive elements of HAZMAT response in terms of overall efficacy are related to the day-to-day groundwork provided by each of the organizational units. Many of the duties and responsibilities of individuals within the AMP are directed specifically at providing preincident support in an attempt to minimize their deleterious effects. Thus, while the fire department has a major active role during an incident, the major active role of BEE/Medical involves day-to-day groundwork before an incident.

Potential and actual incidents have an excellent forum for open discussion assured by headquarters USAF. According to AFR 127-12, the AF must establish AF Occupational Safety and Health (OSH) councils such as Aeromedical Council at every installation with over 500 assigned personnel. The council may be held as a separate and distinct council or may be integrated with the installation safety council; the council is chaired by the Base Commander or his designee. This council provides a forum for discussion of OSH problems, advises the installation commander on OSH-related matters, and makes recommendations to the commander on resolution of OSH problems. Membership on this council includes representatives from functional managers plus representatives from CE, resource management, civilian personnel office, safety, environmental health, fire prevention, BEE, and civilian employees. Meetings are held quarterly to discuss pertinent AFOSH issues.

The following subsections will provide a perspective of how BEE and other medical personnel are tasked to respond before and during incidents, the requirements for preparation and planning, and what is required to ensure that the idealized plan is operationally valid.

2. Bioenvironmental Engineering/Medical Activities Before a HAZMAT Incident

The role of the BEE is laid out clearly in AFR 161-33, The Aerospace Medicine Program, and in interpretative documents such as AFOSH Standard 127-68, Chemical Safety, and AFR 355-1, Disaster Preparedness Planning and Operations. In certain commands, supplementary documentation is provided, for example, AFLC Regulation 161-1, Hazardous Materials Management.

In the chain of command under the AF Surgeon General, the presence of BEE and the medical staff provides the authority for decisions regarding health concerns for all exposures to HAZMATs, both normal and unplanned. Headquarters USAF has provided a structure designed to meet the health needs of AF personnel. For example, the Research Development and Acquisition organization is assigned to see that the research required to determine health risks associated with hazardous chemicals takes place. Thus, once identified, significant uncertainties in health risk from particular hazardous agents can be addressed by a responsible and designated agency within the AF system. The Research Development and Acquisition organization depends on field support personnel to bring to the attention any deficiencies in health and safety knowledge; BEE would normally initiate this reporting.

a. Role of BEE/medical

The intended role of BEE and Medical requires that these organizations place considerable importance on a high level of preincident activity. It is generally considered that the payoff in reduced frequency and severity of HAZMAT incidents makes up for the up-front effort. Specifically, BEE must screen all materials entering every base. AFOSH Standard 127-68, Chemical Safety, calls for BEE to play a pivotal role:

- (1) in determining compatibility questions;
- (2) in ensuring the maintenance of a comprehensive, up-to-date set of MSDS that contains information sufficient for health protection;
- (3) in ordering chemicals by assuring that the least toxic materials for the job are procured and in not greater than necessary quantities;
- (4) in storing chemicals by inspections and requirements for health and safety needs;
- (5) in training by ensuring that supervisors are properly trained in the safe handling of chemicals and that their staff is properly instructed;
- (6) in equipping personnel with protective equipment (operating personnel have, properly use, and maintain adequate equipment); and
- (7) in training for spill emergency measures (all appropriate personnel are trained for spills of chemicals in possession or in likely contact).

As dictated by AFOSH 127-68 annual medical examinations are performed on personnel routinely exposed to hazardous chemicals. In addition to annual check ups, personnel checkups are conducted on a case-by-case basis following real or suspected exposure to HAZMATs. The accepted criteria for monitoring is if the exposure involved is over half of the TLV. Below half of TLV, no monitoring is required.

b. Special attention needed by fire department

The guidance and requirements in AFOSH 127-68 are designed to provide complete coverage for all AF personnel and AF employees; they explicitly point to the primary users of hazardous chemicals (i.e., shop workers). However, first-response personnel are "secondary users" of these materials during HAZMAT incidents. That is, they do not use the materials in day-to-day work like shop personnel would, but rather, they may be involved in an unintended role—that of stabilization of an incident involving hazardous chemicals. Implicit in AFOSH 127-68 are the directives to the BEE/Medical organizations to make sure that fire department personnel are trained and equipped to assure health protection as they carry out their mission as first respondents.

A natural outgrowth of the main directives would to require BEE to treat the fire department in the same way as other AF personnel but with the provision that fire department personnel may encounter, under adverse conditions, any HAZMAT on base. Thus, training and informational requirements for every HAZMAT on base must be met by and for fire department personnel. Such a requirement places a heavy demand on the readiness, training, knowledge and equipment needs of fire department personnel. It further places a significant responsibility on BEE/Medical readiness, training, knowledge, and equipment to assure that these OSH requirements are achieved and maintained by the fire department.

c. Inspection

In addition to training, a key element in prevention and hazard minimization is that related to inspections and evaluations. The Air Force Occupational Safety, Fire Prevention, and Health (AFOSII) Program AFR 127-12 provides directives relative to inspections, evaluations and surveys. The safety and fire prevention inspections and health evaluations or surveys of all AF work places must be performed at least yearly. High interest areas must be inspected or evaluated at least twice a year by the staff agency (fire prevention and health) responsible for evaluating the type of hazard involved.

The BEE keeps an inventory of HAZMATs and monitors their usage area. Annually the BEE must inspect all shops where potential occupational hazards exist. In some high hazard areas, inspections are more frequent. During these inspections, the BEE completes AF Form 2761, "Hazardous Materials Data," for each building to track HAZMATs and potential exposures. In addition, the BEE documents which shops have been inspected, date, and response to problems and questions. These records are on form 2758, "Industrial Hygiene Survey Data Sheet-General." The usage inventory of HAZMATs and exposure information could provide a basis to prepare inventory lists to build upon for response to incidents.

A variety of issues may be examined during these inspections. Of particular interest here is the opportunity for the BEE and the fire inspector to meet at the location of a possible HAZMAT incident. They have an opportunity to inspect together the shop's inventory of HAZMATs. The AFLC has amplified AFR 127-12 with AFLC Regulation 161-1, Hazardous Materials Management, and requires that each shop supervisor maintain a shop inventory of HAZMATs and conspicuously post it at or near the entrance to the area or room where the HAZMATs are stored or used. By evaluating the actual shop inventories against those listed, BEE can determine the degree of accuracy of the lists. Other commands require that each shop inventory be described and maintained in a single location. This is usually at the BEE office, and these records can be evaluated during actual shop inspections.

Accuracy is important and a master base inventory is to be made up of these shop inventories in the AFLC. The master inventory is

to be centrally maintained and continuously updated. Distribution to base emergency response agencies is at least quarterly. The master inventory will identify NSN, manufacturer and trade name, unit of issue, quantity (on hand and consumption rate), physical location, organization, supervisor, and RCRA waste contribution (quantity and identification number).

d. Specific directives within AF Logistic Command

In addition, the Environmental Health Services of the AMP, under which the clinical occupational health program is organized, is directed by AFLC Regulation 161-1 to:

(1) coordinate safety and health training requirements with appropriate agencies to include the local Hazard Communication written plan,

(2) provide supervisor safety and health training required by this regulation,

(3) provide general HAZMAT training for workers with a significant potential for exposure to HAZMAT within their work area,

(4) provide medical oversight and technical assistance to supervisors to aid them in their specific HAZMAT training program for chemicals and processes under their supervision, and

(5) certify the adequacy of the safety and health training programs.

The provisions of Regulation AFLC 161-1 also include directives to the BEE. They are to:

(1) perform hazard evaluations for all new industrial processes and chemical application,

(2) maintain the base master HAZMAT inventory and distribute current copies to base emergency response agencies at least quarterly;

(3) maintain and distribute (upon request) HAZMAT information, which is accessible immediately on a 24-hour basis to emergency response agencies,

(4) assign supply codes to the issue of HAZMAT to organizational accounts with approved use of these materials,

(5) review new product MSDSs for completeness of safety and health information, and

(6) utilize the annual industrial shop survey to validate the base master HAZMAT inventory and certify that existing chemical

usage minimizes workplace hazards and the quantity of hazardous chemical wastes generated.

e. Safe work environment under all contingencies

The above discussion reveals that the BEE and USAF Medical Service have clear mandates to provide as safe a working environment as possible under all contingencies. Further, these organizations are directly responsible for carrying out a wide variety of preincident activities that directly support HAZMAT responses. These preincident activities provide a basis for support during an incident and work to minimize the effects by:

- (1) locating inventories,
- (2) minimizing inventories,
- (3) assuring proper training of incident response personnel, and
- (4) identifying and acquiring appropriate protective clothing.

Proper implementation of regulations ensures that BEE is familiar with most hazards that may be encountered during an incident, thus the knowledge base and much groundwork have already been established. These facts are important when viewing the BEE and Medical service response during a HAZMAT incident.

3. Bioenvironmental Engineering/Medical Response During a HAZMAT Incident

Incident response varies with the scale or size of the event, and the first responder makes the initial determination as to the level. At most installations, emergency calls simultaneously go to fire protection, security, and medical. Normally, BEE must be notified separately (usually by fire protection). Fire protection often arrives ahead of other personnel as a result of their 24-hour response status. The fire department determines the scale of the incident and may choose to assemble the DRG. It is the fire department's prerogative to call upon the BEE for Level I and Level II spills. Under present conditions, HAZMAT specific job categories and/or personnel are not authorized in the fire department. There is a need for information from the BEE, who should be called to HAZMAT incidents simultaneously with the fire department. Incorporation of this step into standard operating procedures puts responsibility with authority.

Once the DRG is assembled, the OSC may require advice from BEE or Medical. Such advice from BEE may be in the form of:

- (a) Allowable short- and long-term exposure limits. To provide immediate advice to the OSC at the scene of a chemically related emergency.

(b) Environmental factors to consider during recovery.

- Predict the immediate and future movement of released hazardous substances through the geologic and hydrologic environment and air;

- Assess the effect of this movement on the quality of groundwater, surface water, and air;

- Determine the probable movement of released toxic gases;

and

- Predict the exposure levels of people and the ecosystem to the materials.

(c) Personal protection measures required for the public and worker safety from potential health hazards and applicable environmental quality standards. The type of equipment recommended and overall level of protection should be reevaluated periodically as the amount of information about the site increases and as personnel are required to perform different tasks. With the concurrence of the OSC, the level of protection may be upgraded or downgraded.

Reasons to upgrade are:

- known or suspected presence of dermal (skin contact) hazards,

- occurrence or likely occurrence of gas or vapor emission,

- change in work task that will increase contact or potential contact with HAZMATs, and/or

- request of the individual performing the task.

Reasons to downgrade are:

- new information indicating that the situation is less hazardous than was originally thought,

- change in site conditions that decrease the hazard, and/or

- change in work task that will reduce contact with HAZMATs.

At the direction of the OSC, BEE may sample and test the affected environment to monitor the extent of pollution caused by the spill. Medical assists the OSC by:

(a) dispatching medical personnel and an ambulance(s) to the site;

(b) rendering emergency treatment including decontamination and removal of injured personnel for treatment;

(c) maintaining familiarity with the symptoms of exposure to onsite hazardous substances and by being able to either provide necessary treatment or secure treatment from other qualified facilities; and

(d) providing the OSC with current and followup information on injured personnel as soon as possible.

The above description of the role of BEE and Medical evaluation procedures appears to define BEE/Medical under the conditions of a HAZMAT incident. In principle, most of the contributions to support the fire department have been in the preincident stage. This support would have been in the form of characterizing hazardous inventory on base, advice regarding personnel protective clothing, and advice on HAZMAT training programs. From the first responder's point of view, the questions are, "Is the system working?" "Is everything in place?" and "Will the system work when required?"

4. Critique on the Support Role of Bioenvironmental Engineering/Medical to the Fire Department at HAZMAT Incidents

A review of the pertinent documents, as well as discussion with USAF personnel, provides a perspective on the BEE/Medical and fire department interface under conditions of a hazardous incident. Although USAF has provided a framework that is both necessary and sufficient for timely and appropriate practices to be carried out by BEE/Medical in support of all HAZMAT incidents, the framework is not always supported by staffing needed for optimal implementation.

a. Availability of inventory information

The major dilemma is the contrast between the health and safety needs of the fire department and the often overextended staff in the BEE/Medical support functions. The fire department personnel risk their lives at each incident response, so every unknown is important. One of the major unknowns is that of chemical inventory at each potential incident site. The BEE is tasked with maintaining a file on each workplace or storage location. Observations by the ORNL task group are that usually such a file is available to some degree. However, this information is not often computer-based or in optimal form for use by the fire department. Some members of fire protection would like to have computer-readable files and they are not always available.

Given that fire department personnel place themselves at risk at every incident, a high level of concern is justified. Translating this concern into action has been the role of various personnel in the different fire departments visited. In all cases, a major emphasis

was on getting a truly representative estimate of chemical inventory. This information is vital to several components of incident response and influences the possible long-term process of training and obtaining special protective equipment and/or decontamination materials.

Fire chiefs must provide for the well-being of their employees so they have pushed for the development of a para BEE/Medical contingent, usually in the form of a single lead person, the HAZMAT leader. Many of the objectives of this HAZMAT component are similar to those of BEE/Medical, except that the motivating forces are different: for BEE/Medical it is the set of regulatory directives to ensure a safe working environment and for the fire department it is a self-preservation motive. The end result of the fire departments' need for information is often the development of a parallel process.

A clear and obvious solution to this situation is an increase in BEE staff. This increase would allow the development of a more responsive posture relative to the needs of the fire department, particularly with respect to inventories. It seems evident that several natural opportunities are already present to foster an improved situation regarding inventory requirements. These will be discussed later in Section IIIJ.

b. Training

A second issue worthy of examination is the role of BEE/Medical in the training of the fire protection personnel particularly regarding HAZMATs. An increasing range of knowledge requirements is being placed on HAZMAT-related individuals. Clearly it is proper that BEE be involved, at least in monitoring these programs to ensure compliance with the intent of the AFOSH program. (Strictly speaking, BEE's role in training could be much greater than has been observed.)

c. Medical monitoring

In the AF, annual checkups by Medical are provided for emergency response personnel. Presently, no additional monitoring is done for emergency personnel. Although fire department personnel are not exposed to HAZMATs routinely, they do deal with unknown situations when they are exposed. The exposures to HAZMATs and unidentified chemicals are not clear; however, many complaints are voiced and court cases are pending.

Exposure to HAZMATs by emergency personnel and medical monitoring are complex matters. Cumulative, long-term effects of exposure to HAZMATs, even for personnel wearing protective clothing, is sometimes unknown. Situations where emergency response personnel are introduced to mixtures of chemicals are even more questionable. Therefore, medical monitoring systems need to be studied, developed, re-evaluated, and revised as more information on health effects becomes available. To counteract any unknown effects of long-term exposure producing health risks, even when protective precautions are taken, perhaps procedures

will be followed to reduce the time length of exposure. Limiting the length of exposure time should minimize the risk.

It would be beneficial for the AF to collect data on fire department HAZMAT personnel. The AF could contribute enormously through a careful program of testing and documentation.

d. Mechanism to voice concerns

Based on collected information, no hazard report has been cited in which the lack of rapid information of chemical inventory has been pinpointed by the fire department. If such a report was needed, it would be simple to prepare, since the USAF hazard reporting program explained in AFR 127-2 provides a system of reporting hazardous conditions and for the investigation and correction of those hazards. Workers are encouraged to make oral reports to the supervisor as that is the most prompt and effective method to abate hazards. Anonymity must be granted if requested and employees have the right of appeal according to AFR 127-2 if they are not satisfied with local action on a hazard report submitted.

The preceding information shows that the support role at HAZMAT incidents provided by BEE/Medical is a part of a larger plan directed toward prevention and planning. HAZMAT incidents should be seen as a part of the normal work of the first responders, and as a consequence, it is the responsibility of the Surgeon General to ensure that safe working conditions are maintained for this group of employees. Guidance and regulations are in place to provide a framework for characterizing the special work environment of the first responder. Adequate provision is made for the reporting of unsafe working conditions, but during the site visits, reports or evidence of an incident requiring a report, were not identified. However, an actual incident is not required prior to filing a hazard report. The presence of a potentially hazardous situation is sufficient cause for such an action.

AFOSH Council is the ideal place to voice fire department concerns. The fire chief has representation on this Council. Any concerns over health and safety issues or HAZMAT inventories can be presented to this forum.

I. EMERGENCY RESPONSE PERSONNEL PARTICIPATION IN INSTALLATION RESTORATION PROGRAM CONTRACT DEVELOPMENT AND ASSOCIATED HEALTH AND SAFETY PLANS

The USAF regulatory authorities have promulgated regulations sufficient to meet the anticipated health and safety needs of all employees and contractors. Explicit guidance relative to IRP is not provided in any of the health and safety basic documents. However, application of the underlying philosophies, concepts, and principles provides sufficient guidance to assure the health and safety objectives of the USAF.

Objectives of the aerospace program are described in (AFR 161-33) Aerospace Medicine Program and in the AFOSH Program (AFR 127-12). The fundamental objectives of these programs were reviewed above in Section IIIH.

The point of contact for IRP activities, especially the contracting agency, varies from base to base. During the course of investigations, like many HAZMAT-related functions, the point of contact was in a state of flux, and the agency or individual has not remained constant during the past year. Observation is that waste management activities are becoming more centralized and focused; this effort is viewed as productive and positive. The BEE can serve as a point of contact for identifying the current IRP point of contact.

1. Installation Restoration Program Contractors and Their Health and Safety Programs

- a. Occupational safety and health under direct Air Force management

As an employer, the USAF has always maintained a strong position regarding the AFOSH concepts. These concepts were reviewed in Section IIIH. While IRP contractors or activities are not specifically singled out within the regulatory framework, individuals are covered by implication since they will be either direct employees or contractors to the AF. For contractors, the AF both agrees and commits to management practices that foster OSH conditions concurrent with and/or better than the OSHA standards cited below.

- b. Occupational safety and health under management through the Army Corps of Engineers

Recently, the trend to have the Army Corps of Engineers function as primary contractors for individual bases has initiated contracts with private industry to provide actual services. Army contract requirements are that the contractor adheres to:

- (1) the requirements of the Corps of Engineers Safety and Health Requirements Manual and Federal Acquisition Regulations 52, 236-13, Accident Prevention;

- (2) the OSHA standards for general industry (29 CFR 1910 29 CFR 1910.120) and the construction industry (29 CFR 1926) and the EPA Standard Operating Safety Guides. Whichever provides the greatest degree of protection will provide the basis for the Safety and Health and Emergency Response Plan (SHERP). The SHERP is required to include programs for:

- hazardous environment protection program to provide personnel protection against exposure to hazardous chemicals.

- medical surveillance to provide for medical examinations and emergency care, including planning for medical treatment after exposure to identified hazardous agents;

- employee training to provide for site-specific training as well as OSHA required off-site training;

- site work zones to reduce the spread by workers of HAZMATs from the contaminated areas to the clean areas;

- personnel protective equipment to assure proper use of personal protective equipment;

- personnel and equipment decontamination to prevent harmful materials from being transferred into clean areas exposing unprotected workers, to provide air-purifying respirators, and to provide an equipment decontamination station;

- emergency provisions to provide anticipated emergency equipment;

- emergency response plan to include all procedures to be followed and contacts to be made;

- monitoring requirements to prepare a plan to monitor for volatile vapors, explosive gases, and heat stress; and

- fire protection and emergency fire response plan to develop a written plan to include procedures and equipment.

These requirements are in addition to the basic safety and health plan. Detailed provisions are clearly in place to assure that IRP activities are carried out in the most safe, healthful, and environmentally acceptable manner.

c. Installation restoration program planning meetings

Under the present mode of operation, these various plans are to be reviewed by the Base Contracting Officer. At least two conferences are held between the engineering contractor and the Contracting Officer. The first meeting would serve as a preconstruction conference. Typically this would be prior to or within 21 days after the contractor has been issued the Notice to Proceed.

At this point, the contractor meets with the Base Contracting Officer. The purpose of this first formal conference is to review submittal requirements, safety, payrolls, labor relations, environmental protection, progress schedules, and payment application procedures and procurement of materials. The principal features of work would be reviewed during this conference and any questions regarding the contract and work sites would be posed and addressed.

During or before this meeting, the contractor submits to the contracting officer the proposed contractor's Quality Control Plan and the proposed Safety, Health, and Emergency Response Plan. The proposed contractor's Quality Control Plan and proposed Safety, Health and Emergency Response Plan would be reviewed briefly to provide the Contracting Officer with a general understanding of these plans. Both of these plans must be approved by the contracting officer before any work is done in contaminated areas.

The second formal conference, a prework conference, generally takes place as soon after the Notice to Proceed as practicable but usually no later than 7 days before starting onsite construction within exclusion zones. This conference is held between the contractor and contracting officer's representatives. Attendance by the contractor's superintendent, certified industrial hygienist, site safety officer, and any major subcontractor's job superintendents is mandatory. The purpose of this conference is to further define the contractor's Quality Control Plan and to develop a mutual understanding of the responsibilities of project personnel. The specifics of the contractor's Safety, Health, and Emergency Response Plan are discussed so that the emergency procedures and safety requirements are understood by all of those directly related to the work. Other issues to be addressed would include a variety of administrative details.

2. Interaction of AF Emergency Response Personnel with Installation Restoration Program Activities

a. Observations

At present, there is no formal interaction between emergency response personnel and the planning processes in the IRP. The present trend is that IRP work is contracted out to private companies, without direct input from on-base emergency response personnel.

Usually the fire department receives an initial formal notification of IRP activities prior to a contractor coming on site. Notification is usually by letter from the Base Commander to the fire department indicating a potential need for their emergency support to the outside contractor.

For the bases visited, there was no indication that emergency response personnel participated in the review of the basic SHERP. In these plans, there is generally no direct planned interaction with emergency response personnel other than during an actual emergency.

b. Recommended improvements

The clear separation of the IRP contractor and on-base emergency response personnel is not viewed as being within the philosophy laid down in documents reviewed in Section IIH. That is, the observed method of operation, which does not explicitly include on-base emergency response personnel in preconstruction meetings, appears to be in

conflict with the philosophic guidance laid down in the basic documents AFR 161-33 and AFR 127-12. Emergency response personnel may be required at some point during the actual implementation phase of the IRP. The observed IRP process, which does not incorporate an active participation by emergency response personnel in the planning of IRP activities, is therefore outside of the AFOSH philosophy.

The two conferences discussed earlier would provide an excellent forum for the base emergency response personnel to interact with the contractor. In addition, it would appear prudent for regular, if not formal, contact between emergency response representatives and the onsite IRP manager to be initiated in the form of co-participation on a Base Safety Council or a subcommittee of that organization. Every AF base has some form of a safety council that answers to the Base Commander. When briefings are being made to various organizations regarding specific IRP actions, pertinent information could be made available to emergency response personnel at the same time.

Since initiative on this interaction point does not appear to have been made by IRP agents, it is reasonable for representatives of emergency response personnel to initiate the question through one of several formal processes available. One such formal process, involving a formal hazard report as detailed in AFR 127-2, was described in Section IIIH. This process is available when an AF employee has identified and reported a hazardous or potentially hazardous situation and no ready response has been achieved (Section IIIF). Another solution involves an agreement between the fire chief and the head of the DRG to have emergency response personnel regularly and formally briefed on planned activities. Such meetings could be concurrent with regularly scheduled IRP briefings.

J. HAZMAT INVENTORY REQUIREMENTS AND OPTIONS FOR IMPLEMENTATION

1. Background

The need for HAZMAT inventory exists for a variety of reasons. Because of the importance of an inventory system, the basis for needs of the different organizations will be summarized here.

a. Bioenvironmental engineering

For BEE, an inventory system can serve as the basis for information under the recent "right-to-know" legislation. It can also serve other functions, including an information source for future health studies. In this capacity it will be necessary to know what chemicals were in which shops and which employees worked there during specific time intervals. Health studies can take the shape of prospective epidemiologic and trend analyses of clinically observable events. Inventory and work place records can serve as an historical record of proximity to HAZMAT exposures for legal purposes.

Consistent with these health-related issues, a complete HAZMAT inventory will allow BEE to review shops where HAZMATs are used and to identify alternative materials of a less hazardous nature, and to determine stored chemicals (presently, the BEE only tracks chemicals used in work areas). Reviews can be made also for the purpose of minimizing onsite quantities of HAZMATs by analyzing the storage-usage relationship. By doing this, BEE can lessen the potential hazardous exposures.

b. Environmental management

A variety of agencies are present at different AF bases to ensure regulatory compliance. Some agencies involved with regulatory compliance are under CE, some under Medical, and some answer directly to the Base Commander. Development of an inventory system could be of significant benefit to any of these organizations.

The primary EM objectives at present have to do with the proper identification of RCRA wastes and the characterization of both airborne and waterborne effluents. In this regard, EM personnel have information necessary to assess the potential for substituting non-RCRA chemicals and for determining the need for recycling certain materials to reduce quantities of materials classified as waste. Inventory flow information also allows for a determination of the appropriateness of losses by evaporation or to waste water systems, thereby providing for identification of fugitive (unplanned) losses.

c. Emergency response

A variety of emergency response organizations can make good use of HAZMAT inventories if specific locations of HAZMATs are known. The fire department is the principal action agency in addition to the two listed above. The primary objectives in a HAZMAT incident are to contain and to stabilize the situation. Thus, it is important for the fire chief to know, immediately, the hazards involved. This information can be used to identify proper response methods, including protective equipment. Plans can be made when inventories are known prior to incidents, prefire, or preincident. Also, planning via inventories may be important to ensure adequacy of training and to assure the presence of an adequate supply of appropriate fire suppression material as well as personnel protective equipment.

2. Options for Inventory Development

A variety of users have needs for overlapping HAZMAT inventory information. Consequently, the possibility exists that a variety of inventory initiatives with similar goals could be maintained by several users. It is necessary to maximize efficiency; therefore, options for data collection will be reviewed.

a. Which materials to inventory?

Not all materials are sufficiently hazardous to be in a HAZMAT inventory. All materials that would end up as RCRA wastes should be included along with OSHA-controlled wastes, CERCLA substances, and the Title III list. The IEX codes 8 and 9 at first seem a reasonable choice to include in inventory for those bases at which these codes are used. Unfortunately, these codes lack a level of specificity, and not all bases use them. In any case, whatever codes BEE uses to assist in health and/or environmental protection could be employed as a starting point. Ultimately, the fire department should be involved in inventory definition along with other potential users.

b. Originating point for data

The supply function is the appropriate agency for initial input. Different bases have different organizations designed to provide the supply function to host and tenant organizations. In addition, some bases have a greater degree of local purchase than others. To effect the development of an inventory, it will be necessary to have input from all types of supply or purchase methods.

Within the supply function, often the agency providing for tenant organizations does not work through the base BEE or otherwise follow the IEX or other standard classification for health or environmental hazard used by the particular base. This situation may also apply to on-base contractors as well as for local purchase items. It will be necessary to have a high level of consistency among the different supply or purchasing organizations and their methods at each base for an inventory system to become functional and effective.

c. Location of HAZMATs

In an inventory tracking system, the location of chemicals is extremely important information for the emergency response personnel and BEE. Up to the point of "sale," Base Supply should have a good knowledge of its inventory. However, once "sold," the precise location of a chemical is not so important to the supply function. The supply function must only know the delivery point or the person who has the authorized supply account. The ultimate location of the chemicals and that of the responsible individual may not be the same. In fact, the chemicals may be redistributed to various locations (portions of a given chemical order going to several locations).

At the delivery point the system loses whatever data the supply function has to contribute; therefore, it will be necessary to identify a method for obtaining this information on redistribution, so that chemical inventories can be developed by location. One method is for individual shop foremen to have a reporting responsibility; another would be to have BEE and/or some emergency response agency become involved. Of all the options, only one seems appropriate and workable: that of the responsible person or office holding a supply

account. For example, if this individual does not provide proper information, further supplies will be withheld. Administrative control of this type is highly effective.

Placing the responsibility for determining the final location at the level of the holder of a supply account provides a good mechanism for accountability. This accountability can take the form of a required periodic (i.e., monthly) reporting of locations of chemicals to the agency heading the inventory program. By placing this responsibility on the holder of a supply account, the number of data sources for the inventory program decreases drastically as compared with other alternatives, such as individual shops. Such a process would place the responsibility to identify final locations and quantities of chemicals with the same person/office that has the authority to purchase them. Thus, responsibility and authority fall into proper relationship.

d. Identification of waste

When a material is at the end of its useful life, it becomes a waste. Wastes will either be RCRA wastes or they will not. It is likely that most hazardous wastes will be derived from either IEX 8 or IEX 9 materials. There is no exact correspondence between IEX codes 8 and 9 and materials classified as RCRA wastes. However, for those materials classified as RCRA waste IEX 8 or IEX 9, very careful tracking must take place. RCRA, as well as other specified waste, is accumulated at defined accumulation points and each of these points has a designated manager. This manager requires specific information for legal purposes before accepting waste, and this point in the process is an ideal spot for requiring source information.

Thus, again, by placing responsibility at a focal source, the accumulation point, requisite information can be obtained. Refusal to receive the waste without identity of the source should be sufficient to ensure compliance. This ascertainment of waste is vital if the system is to provide usable information about HAZMATs on working levels.

e. Working levels of HAZMATs

The fire chief's desired goal for a HAZMAT inventory system is to know the locations and typical quantities of HAZMATs. In principle, by recording incoming and outgoing levels for several months to a year, an inventory of materials with less than a year's practical usage life can be determined. However, in bases where research facilities exist or in shops that have a very slow turnaround of certain materials, a year's observation may not yield much useful information.

It is important to have a systematic program of quality assurance evaluations. This program should include checks at several levels. The first level should be with the person/office holding a supply account. Periodic computer evaluations of shop inventory should be checked manually by the person/office who purchased the materials for the specific shop. Again, as before, responsibility follows authority.

A second stage of quality assurance for working level inventories can come either from an independent agent (custodian of the computer inventory) or from BEE and fire department walkthroughs. For the shops suspected to be most hazardous, this latter option should be employed. This joint BEE and fire department function would be very similar to the present program of annual walkthroughs by BEE and fire department to spot hazardous situations and to maintain familiarity with base facilities.

f. New materials

New HAZMATs may be ordered at any time and quantities may vary from small laboratory bottles to industrial levels. The computer inventory system will not be able to identify a working level until several chemical turnovers have occurred (i.e., months to perhaps a year). Furthermore, it would take at least a month before the fire department could learn of the presence of this new material. A formal process of information transmission from BEE to the fire department would be of assistance for this situation with new materials.

The PEE and fire department interaction for new HAZMATs should involve an agreed-upon protocol. Some of the considerations should be:

- Is the material so highly toxic that location of even small quantities should be identified?
- Is the order a large enough quantity that even if it has a low hazard rating, its arrival should be known immediately?
- Would emergency response personnel have proper equipment to deal with a spill of this new material?
- Is the material similar enough to something already on base that personnel protective equipment already in hand would be sufficient in case of a spill?
- Is the material going to a location where HAZMATs are already present, or would this be the first HAZMAT at the intended user location?

Upon consideration of these and possible other issues, BEE would apprise the fire department that a new material was on order and that it would be delivered to a specific location. This advanced warning would allow the development of a prefire or preincident plan that would include the presence of the new HAZMAT. If warranted, this planning could be accomplished before the material actually arrives on base.

g. Implementation

As discussed in the beginning of this section, a variety of agencies need HAZMAT inventory information. These requirements can be

quite different as exemplified by the discussion of inventory initiatives at three of the bases visited (Section IIB and C).

The AF allows a plurality of mechanisms to operate. In the cases reviewed, one agency in charge of the inventory was doing so as a result of a directive to develop a HAZMAT inventory system. The others are more informal initiatives and are based on a need expressed by the fire chief rather than because of a directive from the Base Commander or command level staff. Whatever the reason for developing an inventory, the fire department can make use of available information.

Facilitation of an inventory system requires constant attention to detail. If a fire chief attempts to persuade the HAZMAT users to send him inventory lists, chances are that there will be a low return rate. However, if there is a command-wide or base-wide directive for organizations to support the inventory initiative, it will be accomplished.

Therefore, a best plan for all bases would be to obtain the support of the Base Commander or major air command in obtaining inventory data. Such participation is absolutely essential to the success of this labor-intensive activity. Conceptually speaking, the fire chief should be a user of an inventory rather than a developer. It seems more logical that either BEE or a regulatory organization carry the development and maintenance of an up-to-date HAZMAT inventory. As long as a line of authority is established, success will follow and regular updates will proceed as per the directive.

h. Interface between HAZMAT inventory and Hazardous Material Incident Management System

The HMIMS, described in detail in Section V, is a computerized system that assists the fire chief in decision-making and incident management. As such, a variety of information types are necessary. Critical points of information are:

- what materials are on base?
- what quantities are there?
- where are they located?

This information can be accessed by the HMIMS electronically from a computerized inventory, given appropriate computer interfaces, that will probably vary from base to base. The use of relational data base management systems and ASCII files will allow data in the HAZMAT inventory to be accessed by the HMIMS.

Inventory systems derived by accessing computer records from the supply function will often contain a NSN and not a chemical name for material identification. This lack of data seems to present a problem in identifying the particular chemical or mixture, but this dilemma can

be addressed by searching the DOD HMIS (now on CDROM disks), which contains all MSDSs obtained through the DOD procurement processes. Chemical names and other pertinent incident-response information usually can be obtained from these MSDSs. Information is then available for use in the HMIMS in assisting the incident respondent. If specific information is not available from the HMIS, BEE should be consulted, since it is their responsibility to assure that adequate information is available for any chemical on base.

i. Need for uniformity

Observations made during the investigators' site visits demonstrated a wide variety of efforts to develop both HAZMAT inventories and incident management systems. Up to a point, this plurality is reasonable; however, plurality carries the cost of redundant development efforts.

It is not within the scope of this work to evaluate economic impact of duplicative efforts from base to base and from agency to agency within a base. Identified above in this section are the three prime users of HAZMAT inventories--BEE, EM, and Emergency Response. Each user has slightly different needs but the informational requirements are essentially the same, and these functions exist at each base. If implementation were the only cost, then each base could rightfully expect to implement its own ideas. However, development costs of an inventory system are an important consideration and should not be incurred except at a few trial locations. The development of a headquarters-level policy on a HAZMAT inventory system and the promulgation of implementation directives are vital to the success of a fully functional HMIMS.

K. PERSONAL PROTECTIVE CLOTHING, EQUIPMENT, AND MATERIALS TO HANDLE HAZMAT INCIDENTS

1. Chemical Protective Clothing and Levels of Protection

Chemical spills may result in dangerous conditions posed by characteristics inherent to the spilled chemicals, the amount of the material, and the environment of the area.

The primary personnel hazards during HAZMAT incidents are associated with potentially harmful conditions arising from fire and health threats. Secondary consideration is protection of the environment through containment and control of spills.

Because the greatest initial risk to human life is usually posed by explosion and fire, these hazards must be adequately assessed and controlled prior to further actions. After ruling out or controlling fire hazards, health risks must be assessed and protected against. Following these efforts, initial actions to protect the environment, such as containment, may be taken.

The initial health and safety activities at a chemical accident consist of steps to identify the materials present, to determine the potential for fire/explosion, and to determine the risk to health and the environment.

When a material is formally classified as a flammable material and a potential for explosive/flammable conditions exists (i.e., sufficient volumes have been spilled), an assessment of these conditions must be made upon entering the area. Under these conditions, special precautions must be taken to prevent all sources of ignition (e.g., static electricity and friction). Where explosimeter values are considered significant (i.e., in the range of 10 percent lower explosive limits or greater), the health risk also must be considered, because under these conditions several thousand parts per million of the flammable constituents are likely to exist.

Adequate preparation for entry into conditions that may pose risks of either fire or health hazards requires an assumption as to the characteristics of the spilled materials. Inherent chemical and physical characteristics such as vapor pressure, boiling point, flammable limits, and toxicity must either be known or assumed to be "the worst-case" characteristics.

The activity of assessing and categorizing conditions has been summarized in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (Reference 19). This document was prepared jointly by the NIOSH, OSHA, U.S. Coast Guard, and EPA. The resulting categories of hazardous waste/material zones are applied to hazardous waste sites and HAZMAT incidents for the purpose of generalizing the degree of hazard. Chemical protective clothing (CPC) and personal protective equipment (PPE) are then selected for the designated zone. The categories or classifications are termed "levels of protection" and are divided into A, B, C, and D. These protection levels were first developed by the EPA Office of Emergency and Remedial Response and have been adopted and applied to most HAZMAT activities. These levels are referred to in the NFA (FEMA) "Hazardous Materials Incident Analysis" Course, Arizona Division of Emergency Service, "Hazardous Materials First Responder Student Manual," Oregon Fire Standards and Accreditation Board, "Accreditation Guide for Hazardous Materials Technician I, II, III, and Supervisor," and in 29CFR1910.120. The AF "levels of protection" are titled as Levels I, II, III, and IV. These levels are referred to in the Chanute Technical Training Center, "Munitions/Hazardous Materials Firefighting," Course No. C3AZR57150 001; in Andrews AFB 1776 ABW Oplan 19-8-87; and in Tinker AFB Firefighting Branch Operating Instruction A-16: Hazardous Material/Chemical Incidents. The Proceedings of the 1982 Hazardous Materials Spills Conference also elaborates on AF hazard levels (Reference 20). These levels are also referred to in AF decontamination procedures. Although AF levels of protective clothing correspond to decontamination levels one-for-one, there is no close correspondence between levels of protective clothing and levels of response.

AF Levels I, II, III, and IV do not correspond to the more universally accepted EPA Levels A, B, C, and D. Level A corresponds with Level III and Level B corresponds with Level II. Levels C and D do not correspond to any of the AF numerical levels.

In this report, available data and various classifications for protective clothing are provided by the EPA classification scheme. This more universal system is adopted by NFA and cited in federal regulations. Published information and data collection are in abundance through this system.

The maximum protection for HAZMAT workers is designated as Level A. Level A protection is appropriate when environmental conditions are such that short-term exposure will result in serious acute health effects or death. Worker protection consists of a totally encapsulated suit with a SCBA. The suit environment is maintained under positive pressure to reduce the transport of hazardous substances into the suit if it should leak. The SCBA is worn inside the suit to protect it from contamination and to provide the air supply to create the positive suit pressure. CPC compatibility with known, released substances is checked before workers enter the hazardous area. Level A protection is also the CPC of choice in cases where the released substance is unknown.

Level B protection provides HAZMAT workers with maximum respiratory protection but a lower level of skin protection. The use of an SCBA is mandatory. Suits with zip-on closure and detachable hoods can be worn. Again, compatibility between the released substance and the suit material(s) must be checked. Level B protection is the minimum protection for initial HAZMAT response team members.

Level C protection is used when criteria for a released substance allow the use of air-purifying respirators. In other words, this level is selected when types and concentrations of respirable materials are known or have adequate wearing properties. Protective clothing consists of coveralls, splash protection, faceshields, gloves, and boots. However, continuous monitoring is required to protect workers from sudden releases of other substances or increased concentrations of released substances.

Level D protection includes only basic protective clothing. An emergency escape mask is an important component of this equipment and is to be used in a sudden or unexpected release of substances. Air monitoring equipment should also be used.

Each incident of a hazardous chemical spill must be evaluated as a unique event with unique characteristics, which are used to determine the level of protection required by HAZMAT personnel. Site-specific parameters are to be evaluated by trained, qualified personnel. When the released substance, level of concentration, and worker-contact possibilities are unknown, the selected level of protection must be based on professional expertise and judgment, but generally "worst-case"

conditions must be assumed. In addition to CPC and equipment, measures such as safe work procedures, decontamination, selection of site-entry requirements, and other safety practices increase overall protection of HAZMAT personnel.

2. The Chemical Protective Clothing Selection Process

The CPC selection process for HAZMAT incidents involves reviewing data as well as balancing many competing factors. The CPC selection process for a HAZMAT emergency response program should provide response team members with the best possible protective clothing and equipment as well as be cost-effective (References 21 and 22). These somewhat conflicting goals can be met by carefully evaluating the HAZMAT emergency response needs in a base-specific manner. To do so requires that people with both the technical expertise and a detailed knowledge of base activities relative to the transport, use, and storage of HAZMATs be involved in the CPC selection process.

There are two levels to the selection process for HAZMAT emergency response programs. The first level involves selecting an inventory of HAZMAT CPC and PPE to be maintained at the base fire department. PPE is a generalized category that covers all protective devices such as respirators, SCBA, goggles, faceshields, gloves, hoods, splash suits, FES, etc. Because of the variety of hazards or risks associated with chemical spill emergency response, this inventory must include CPC and PPE capable of adequately protecting the HAZMAT team members in a variety of different emergency response environments. The second level of the selection process involves selecting the appropriate CPC and PPE from the previously established inventory for response to each HAZMAT incident.

When enough information is available at the "spill scene," the BEE or Health Physics Advisor must select appropriate CPC and PPE for response personnel (AFOSH Standard 127-68). Because responders' lives could be at risk, the general inventory at the fire department must be routinely checked and updated to assure that proper clothing and equipment are available when needed.

3. Base HAZMAT Assessment

Advanced planning is an important aspect of the CPC selection process and should include a review of past HAZMAT spill/incidents. Records should be analyzed to determine where spills occurred most often and what types of chemicals and volumes were typically involved. This information can be helpful in determining appropriate types of CPC and PPE that may be needed by the fire department (and in particular the materials needed for more expensive FES). Integration of the chemical inventory list with the analysis of past incidents is herein referred to as the Base HAZMAT Assessment (BHA). The BHA provides groundwork for the selection of a base specific HAZMAT CPC and PPE inventory.

AFOSH Standard 127-68 defines the makeup of the chemical spill emergency response team to include: the fire department, the BEE or Health Physics Advisor, and the BEC. The team may vary by command and by the needs of the individual HAZMAT emergency. Decisions pertaining to CPC selection and sampling techniques at the spill site are to be made by the BEE. The BEE and fire department are also responsible for "periodic visits" to areas of chemical hazard and are to be consulted before chemicals are ordered. Furthermore, the BEE and fire department are to advise on proper handling and use of chemicals at the base and before potentially incompatible chemicals are stored together.

Additionally, AFOSH Standard 127-68 mandates a base specific inventory of extremely toxic chemicals and chemicals stored in large volumes (and their locations). This "inventory list" should be verified regularly and updated during the walk-through inspections (AFOSH Standard 127-66).

4. Base Specific Chemical Protective Clothing Inventory Selection

The BHA should ideally be completed before extensive CPC selection and requisition. However, if this is not possible, the CPC selection process can be easily "updated" and refined to incorporate information obtained as a result of a BHA.

No one CPC material will adequately protect responders from all chemicals (References 21, 22, and 23). Because of the potential risks involved for responders and the inability of one polymer to provide protection from all chemicals, the selection process is complex and involves several levels of decisions. First, the need for a specific garment must be identified (e.g., an FES). There are several different polymers (and layered combinations of polymers) used in construction of these suits that have unique permeation characteristics relative to different hazardous chemicals. Materials used in protective garments include, but are not limited to butyl, chlorinated polyethylene, natural rubber, neoprene, nitrile, polyethylene, polyurethane, polyvinyl alcohol, PVC, Saran®, treated woven fabrics, and composites of these materials (Reference 24). The BHA should be consulted to determine the composition of the suits [i.e., to select polymer(s)]. Chemicals identified in the BHA as having the highest potential for spillage or those that are spilled most frequently should be checked against permeation data (both manufacturers' and open literature data) to determine the appropriate suit composition (References 22, 25 and 26). This approach makes it possible to select the suit that affords the greatest protection for "more commonly encountered" chemicals. When funding is important, the choice can be made more easily by identifying one suit that provides the greatest range of coverage. However, if an AF base has a large inventory of HAZMATS and a history of frequent spills, several fully encapsulating suits constructed of layered polymers may be necessary to provide adequate protection for emergency responders.

To ensure that the proper CPC is chosen, people with the required technical backgrounds must be involved in the selection

process. Because of their expertise and experience with base operations relative to chemical safety and emergency response, the BEE, BCE, and fire chief should participate in these selections. Additionally, it is recommended that an industrial hygienist be involved in the final selection process.

The CPC and PPE lists provided in Appendix B of this report outline the basic CPC and PPE needs for a HAZMAT emergency response team. Although these lists are not all inclusive, they include commonly used clothing and equipment necessary for responding to different "chemical emergency scenarios" based on the required levels of protection. These lists present generic types of CPC that individual AF base HAZMAT teams should consider acquiring, depending on their specific needs. Once the generic types of CPC needed are identified, a more detailed selection process must be used to determine the appropriate material(s) of construction (polymer or polymer layers). Data on materials of construction are provided in Appendices C through H.

Because certain pieces of the PPE are more likely to have significant contact with liquids, attention should be focused on these PPE items, particularly gloves, FES (both positive and negative pressure), footwear, and splash suits. These items must have the ability to withstand the chemical that is encountered (i.e., do not degrade and provide protection against significant permeation).

5. Chemical Protective Clothing Selection Factors

The three most important factors that must be considered when selecting a specific type of CPC are: (1) exposure situation, (2) toxicity of the chemical(s) involved, and (3) permeation data (Reference 21). Additionally, secondary factors to be considered are comfort, dexterity, cut and tear resistance, quality control, and heat stress.

While several different types of "chemical protective suits" offer protection against various types of chemicals and exposure situations, the four suit types of interest for emergency response situations are: totally encapsulating chemical-resistant suits (positive and negative pressure), flash protection suits, splash suits, and disposable chemical resistant suits. Each of these suit types will be discussed relative to available materials of construction, permeation data, and chemical compatibility.

a. The exposure situation

Assessing the exposure situation for an emergency response incident can significantly influence CPC selection. There are four basic exposure situations: (1) splash, (2) liquid contact, (3) high vapor concentration, and (4) intermittent liquid contact. (Reference 21). During HAZMAT response activities any combination of these four situations is possible.

By either knowing or being able to predict HAZMAT exposure situations (based upon case histories in the BHA or site specific-information during an actual spill) intelligent, cost-saving CPC selections can be made. For example, if spill records of a given AF base indicate that most of the chemical incidents involve small volume jet-fuel spills related to overfilling tanks, the HAZMAT response team should not attempt to acquire a complete line of level A, fully encapsulating positive-pressure suits. A "situation-specific" example would be a response incident involving a large oil spill on a concrete pad. The exposure analysis by the BEE or Health Advisor at the scene indicates that liquid contact with boots and, possibly, hands are the most probable exposures. In this case boots or boot coverings, gloves, and a splash apron or suit (of appropriate construction) would afford adequate protection. Obviously, sending responders to the scene outfitted in FES would be costly and present unnecessary hazards.

Assessing the exposure situation for HAZMAT emergency response situations is often difficult because of severe time constraints. Historical information from the BHA can be useful as a general screening tool for CPC inventory selection. However, an exposure situation analysis must be performed for each HAZMAT incident to select the appropriate protection from the inventory available. Emergency responders must sometimes "over dress" when complete information is not available, as in the preliminary stages of a HAZMAT event.

b. Toxicity of chemicals

Determining the toxicity of a given chemical is probably the most difficult part of the selection process (Reference 21) because dermal exposure risk data are generally scarce or nonexistent. Toxicological information such as rodent LD₅₀ results and human skin permeation data are available for some chemicals but typically difficult to interpret and usually not adequately compiled and synthesized (Reference 21). It is recommended that someone with an industrial hygiene or general toxicology background should be involved in evaluating chemical toxicity in terms of CPC selection if useful information cannot be obtained from available resources (manufacturer, literature, etc.).

c. Permeation data

Permeation data are the most useful information for selecting the proper CPC for a given HAZMAT incident. Information regarding the physical state and relative concentration of the chemicals involved should also be available.

Permeation is the process by which a chemical passes through the molecular structure of a "barrier material," in this case, the CPC polymers. The ability of a CPC polymer to resist permeation by a chemical must be considered before a specific type of CPC is selected for an emergency response. If CPC is composed of a material readily permeated by the spilled chemicals, the CPC would provide minimal protection from the hazard and increase the responder's risk.

To avoid exposing responders to unnecessary risks, permeation data should be consulted. However, there are several references for permeation data, and the data frequently are incomplete and of questionable quality (Reference 21). For example, during a HAZMAT incident involving anhydrous diethylamine, the face shield of a responder (from the San Francisco Fire Department's Hazardous Materials Team) suffered severe damage (decomposed). This experience illustrates the importance of a technically sound selection process. The permeation data source that had been referenced recommended butyl rubber suits but had not considered the faceshield, which was made of polycarbonate. All components of CPC (including the faceshield, exhaust valves, footwear, gloves, etc.) that are exposed to the hazardous environment must be evaluated for chemical compatibility.

Permeation charts are published by several manufacturers and are available in the open literature. Several of these charts and tables are included in Appendices C through H. Depending on who performed the test, the test procedures used, the test equipment used, and other factors recorded there may be variation in the results for the same polymer (Reference 21). Computer data bases that combine data from both manufacturers and the open literature are now available. Two such data bases are: CPC base (Version 1.0, Arthur D. Little, Inc., Cambridge, Mass.) and Chemical Degradation Data Base and Selection Guide for Resistant Protective Materials (Version 1, Instant References Sources, Inc., Austin, Tex.). Another compilation of permeation data is provided in Guidelines for the Selection of Chemical Protective Clothing, which is available through the American Conference of Governmental Industrial Hygienists, Inc. (Reference 22) and has been included in Appendices C and H. These information sources have an advantage as they were compiled outside the manufacturing community and may be considered to be objective. The computer data bases are recommended for their extensive information and ease and speed of access.

Some caution must be exercised when using permeation data to select appropriate CPC polymers for various chemicals. Manufacturers' data are commonly expressed in qualitative terms such as "excellent" or "poor." This type of general information is virtually useless unless these terms are quantified. Another parameter typically reported for CPC polymers is "breakthrough time." This is the time elapsed between applying a "challenge" chemical to one side of a polymer and the detection of the chemical on the opposite side. The detection indicates that the polymer has been permeated by the "challenge" chemical. Breakthrough time is often misinterpreted. It is assumed that during the time before breakthrough, there is no exposure. Because detection of breakthrough is limited by the detection limits of the testing equipment, such reasoning can be fallacious (Reference 21). A breakthrough below detectable limits potentially could put the responder at risk, especially for highly toxic materials such as potent carcinogens. It is important to examine the permeation rate in combination with breakthrough time. A polymer may have a short breakthrough time but a significantly low steady-state permeation rate, which could indicate that the material may be good material for specific chemical hazards.

Comparing permeation data for the same material made by different manufacturers can pose problems, because permeation rate is affected by several factors: the manufacturing process the source of polymer resin, additives, and quality control (Reference 21). Other important factors affecting permeation characteristics of polymers that are typically not quantitatively determined include thickness of the polymer and temperature during testing. A further complication involves permeation characteristics of polymers for chemical mixtures. Characteristics of mixtures are virtually unknown and represent a significant problem for those involved in selecting CPC for HAZMAT incidents (Reference 21).

d. Other factors

Other factors must also be considered. How well does the garment fit? An FES that doesn't fit can further endanger a responder just as an improperly fitted respirator or a pair of gloves. Improperly sized garments restrict mobility and are more prone to tearing. General dexterity allowed by the garment is another important factor. For Levels A and B protection, a CPC ensemble is required. All components of this ensemble must function together to protect the responder. Cut-and-tear resistance data for CPC polymers should be examined for situations where considerable movement in restricted areas is required and objects such as barrels or tools are handled. For Levels A and B with FES, heat stress becomes a major problem and responders must be carefully monitored. Incorporation of a cooling vest into Levels A and B ensembles can be an effective way to deal with heat stress (Reference 27).

6. Selected Chemical Protective Clothing Types

a. Fully encapsulating chemical resistant suit

A fully encapsulating chemical resistant suit provides the highest level of protection from chemical exposure for a HAZMAT responder (required for Level A protection). These suits are used when high concentrations of airborne substances that may severely affect the skin are known or thought to be present. Level A suits are also used in confined, poorly ventilated areas when high concentrations of toxic vapors, gases, or particulates are anticipated or may be encountered. Any response situation involving highly toxic substances that pose a risk of skin sorption (e.g., fuming corrosives) requires a totally encapsulating suit.

(1) Materials of construction

Reusable FES are typically composed of thick polymer films or polymer-coated materials. The most common suit polymers are butyl, chlorinated polyethylene, polyvinyl chloride, and VITON®. The use of multiple layers of different polymers ("hybrid suit fabrics") with the FES polymer is a relatively recent trend that is significantly increasing the chemical resistance of FESs (Reference 24). Two of these

hybrid suit fabrics, Vautex® and Betex®, are available and are composed of Viton-on-nylon-on-neoprene and butyl-on polyester-on-neoprene, respectively. Two other recent breakthroughs in FES fabrics are CHEMREL® (patent pending, Chemron, Inc.) and Challenge® 5200 (product of Chemical Fabrics Corporation, Inc.). The CHEMREL® FES are limited use garments and will be discussed later. The Challenge® 5200 material is a supported fluoropolymer composite incorporating Teflon®, trademark of DuPont (see Appendices D, E, and F).

A major problem with expensive, fully encapsulating suits is decontamination. Nondestructive techniques for assessing the amount of contamination present in the suit before and after decontamination are not available. Contamination of the polymer matrix is virtually impossible to remove and may work its way to the inside surface of the garment, exposing the next responder when the suit is donned. CPC must be properly inspected before wearing. Appendix C contains a checklist for inspecting all types of CPC. Decontamination procedures vary but some (such as heat drying or high-pressure freon showers) degrade the polymer and decrease its lifespan (Reference 28).

One way to alleviate this problem is to have responders wear an inexpensive disposable cover suit over the expensive reusable suit. Cover suits made of TYVEK® laminated with SARANEX® offer another layer of chemical protection and protect the suit from direct contact with the hazard. The CHEMREL fabric provides even better chemical protection and can also be used as an outer cover garment.

(2) Permeation data and chemical compatibility

At this time, the Challenge® 5200 fabric is unsurpassed in chemical resistance and represents a significant improvement in CPC fabrics. As might be expected, these FESs are very expensive. Butyl rubber is probably the most common material used in the construction of FES, and butyl rubber exhibits resistance to many contaminants (exceptions being halogenated hydrocarbons and petroleum compounds). VITON®, a fluoroelastomer similar to Teflon®, is an expensive material with excellent resistance to aromatic and chlorinated hydrocarbons and oxidizers, but is degraded by some common compounds such as acetone.

The U.S. Coast Guard has been involved in an extensive FES material testing program and recommend selection of an FES based on chemical compatibility information. Once again, this selection process includes an assessment of the chemicals most likely to be encountered.

Appendix C is an extensive CPC material-chemical compatibility matrix taken from Guidelines for the Selection of Chemical Protective Clothing (Reference 22). It presents material-chemical compatibility data, where available, for the FES materials mentioned above (except for Challenge® 5200). Permeation data for the Challenge material are presented in Appendix D. Other specific manufacturers' data for hybrid fabrics and polymer blends, are presented in Appendices E, F, and G. Appendices B through H are intended for use as a

"selection resource." The limitations of using this type of data must be considered.

Another factor with a direct bearing on the protection afforded by an FES and which must be considered involves evaluation of FES components. Most tests evaluate the suit polymer but do not evaluate suit components such as the faceshield, faceshield gasket, and exhaust valves. These components are more susceptible to chemical attack and omitted from testing. Since chemical resistance of an FES is only as good as its most susceptible parts, it is recommended that information on these parts be obtained from the suit manufacturer.

b. Flash suits

Flash suits are designed to provide limited time protection in case a flash fire occurs. According to Fyrepel® Products Inc., 80 percent of all chemicals are flammable and (or) explosive.

Three types of suits are designed for thermal protection. These are approach suits, proximity suits, and fire entry suits. Each of these suit types provides varying levels of thermal protection for working in a "fire environment." When there is a possibility of a flash fire at the chemical spill incident (not an actual fire at the scene), a flash suit should be worn over CPC. Flash suits are designed for flash fires only.

(1) Materials of construction

Flash suits have various internal layers (typically Nomex®), but all have an aluminized outer cover. This outer layer is highly reflective, provides limited thermal protection, and is a limited barrier for steam, liquids, and weak chemicals. Because flash suits do not provide chemical protection, CPC must be worn underneath the flash suit.

Because these layers of materials increase the risk of heat stress, some type of cooling equipment should be included if the suits are to be worn for extended periods. The conditions and length of use of these suits should be evaluated by a health professional for the specific conditions of use.

c. Splash suits

Splash suits are the first line of protection for HAZMAT personnel against a sudden spray of a hazardous substance. These suits prevent the extensive contamination or destruction of the primary suit that may result upon contact with a large quantity of a hazardous substance. Splash suits can provide protection against organic chemicals and highly corrosive acids and caustics. These suits can be manufactured from a single material or a combination of materials and are recommended for use as disposable clothing. It is recommended that such suits be used when reusable encapsulated suits are worn, because of the

extremely high replacement cost of the latter. The use of splash suits can also reduce the amount of cleansing and rinsing solutions and generated waste due to decontamination of the primary suit.

d. Disposable suits

Disposable and limited use CPC is a topic currently receiving attention. A significant amount of research involves determination of breakthrough time for CPC polymers, costs of disposable CPC, and effectiveness of decontamination procedures.

The cost of CPC varies greatly and disposable suits offer an initial savings. Level A fully encapsulating reusable suits are also very expensive (typically range from \$1 to \$3,000) relative to disposable fully encapsulating suits (typically \$50 to \$100). The cost factor makes disposable chemical resistant suits an attractive alternative. However, the question of how well these garments protect the responder is also critical.

(1) Materials of construction

Currently two disposable CPC fabrics are dominating the field of disposable CPC. Both of these materials, SARANEX®-laminated TYVEK® and CHEMREL®, are limited use hybrid fabrics that provide good chemical protection against a variety of chemicals. A SARANEX®-laminated TYVEK® fully encapsulating positive pressure suit has been designed which provides the same degree of protection as the one-piece butyl suit (Reference 29). Because the disposable suit weighs much less, heat stress for the worker is reduced and greater mobility and comfort are provided. At the time of his study, Garland and co-worker estimated the butyl suit cost \$150 to \$200 per wearing (due to high maintenance costs), whereas, the SARANEX®-laminated TYVEK® suit cost is approximately \$40.

The CHEMREL® fully encapsulating suit is another significant breakthrough in limited use CPC. The CHEMREL® fabric is a laminated material containing polar and nonpolar polymer layers, which give the CHEMREL® fabric superior chemical resistance.

(2) Permeability data and chemical compatibility

The CHEMREL® fabric was tested by the Radian Corporation against some of the same chemicals which DuPont has tested SARANEX®-TYVEK® fabric against. CHEMREL® was superior for 37 of the 39 chemicals used in this test. Results for the other chemicals were the same as SARANEX®-TYVEK® (Appendix E). When the CHEMREL® results are compared to MSA's reusable Level A fully encapsulating Chempruf II suit fabrics (VAUTEX® and BETEX®), out of eight common chemicals the CHEMREL® fabric results are superior on four, undetermined on three, and inferior on one (Appendix F). CHEMREL® suits are relatively inexpensive (starting at \$75), making them cost-effective.

7. Chemical Protective Clothing Selection Logic

From the preceding discussion it is clear that CPC selection is a complex process with many, often competing, factors to consider. With all the variables involved, it is important to follow a selection process that provides a method for logically sorting the necessary information. NIOSH has published a selection guide titled "Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide" (Reference 23) that provides this type of selection methodology. Part I of this document describes the factors which must be considered in making a "rational selection." Part II of the NIOSH document contains a step-by-step decision logic for selection of respirators, protective suits, and ancillary equipment. This publication is available through the American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio. In general, the document is a valuable resource in establishing and maintaining a HAZMAT emergency response CPC/PPE program.

Use of disposable and limited-use chemical protective suits alone is not recommended for Level A protection. However, recent developments in polymer chemistry, as discussed in the previous sections, are likely to change this situation. At this time, the safest and least expensive ensemble for situations involving unknown chemicals is a reusable, totally encapsulating, positive-pressure suit incorporating a cover garment composed of SARANEX®-TYVEK® or CHEMREL® fabric. This ensemble has these advantages: increases total chemical protection for the responder, protects the more expensive FES from direct contact with the chemical environment, and is cost-effective. Based on the "spill incident environment," a disposable suit may provide sufficient chemical protection for the responder without requiring the use of a more expensive FES. Because of their lighter weight, greater comfort, reduced heat stress, and cost-effectiveness, disposable suits are desirable when appropriate for the situation.

It is not possible to provide detailed, site-specific recommendation for an inventory of CPC without having surveyed each location. Primarily, information deemed necessary to provide reliable recommendations for an inventory include:

- a. historical information on size, identity, and complexity of previous chemical spills chemical inventory of stored, handled, and transported chemicals
- b. numbers of responders
- c. current practices and procedures used in handling and transportation of hazardous chemicals and the rapidity with which CPC stocks may be replenished.

The steps listed should be followed to achieve the user's goals of selecting CPC.

a. Define the chemical threat

- (1) Identify the chemical or chemical class
- (2) Specify the physical form of the chemical, that is, solid, liquid, or vapor
- (3) Acquire information on the mode of action of the chemical, that is, irritant, corrosive or toxic
- (4) Search the literature for supporting information such as TLV or STEL

b. Define the exposure profile

- (1) Determine whether the user will be exposed to vapor, splash, or deluge of the chemical
- (2) Specify the frequency of exposure, that is, limited, intermittent, or continuous
- (3) Specify the type of exposure, for instance, escape, maintenance/repair, or entry/cleanup

c. Determine the degree of protection required

- (1) OSHA guidelines
- (2) Material safety data sheet
- (3) User experience
- (4) Other

d. Select garment design and material

- (1) Vendor's data sheet
- (2) ACGIH Guidelines for the Selection of Chemical Protective Clothing
- (3) HAZARDLINE

e. Specify accessory equipment

- (1) Communication
- (2) SCBA
- (3) Air supply
- (4) Cooling

A questionnaire developed by MSA, including the above items, can be used in CPC selection (Reference 30).

If it is assumed that an incident should occur which requires Level A protection, each responder should have a minimum of one complete outfit of gear as listed in Appendix B Table B.1. Additionally, there should be at least one spare cooling vest and air tank (for recharging and/or refilling) for each responder. For single-use items such as gloves and underwear, at least three changes should be stocked.

For Levels B, C, and D incidents, the key factors in determining the recommended inventory are the likelihood of occurrence, the probable duration, and the number of responders. Generally, it is assumed that an incident restricted to the base would not exceed a 2-day duration. Therefore, for each responder, it is recommended that sufficient CPC should be stocked to support two shifts of response. At least 12 units of all single-use items (from Appendix B, Tables B.2, and A.4) should be available.

Due to financial or other constraints, it may be necessary to maintain a minimum inventory of CPC and yet one which still provides protection to responders. If this is the case, it is well to remember that CPC from Appendix B, Table B.1 (Level A CPC) may "double" for a Level B, C, or D response, and Level B chemical protective clothing may be used for a Level C or D response and so on, but *not* vice versa. However, several problems exist with trying to minimize CPC inventory in this manner. Generally, the higher the level of protection provided, the heavier, the bulkier, the hotter, and the more expensive the CPC is expected to be. In the final analysis, it would cost more to maintain a "bare minimum" inventory of CPC than to stock appropriate equipment for each level of response.

8. Respirators

The use of respiratory protection is specified on the basis of hazard level, either actual or anticipated hazards. Since there are unique limitations to each form of respiratory protection, certain steps are essential to ensure that the appropriate type of respirator is selected and that the respirator is properly used.

Preparation for the use of respiratory protection includes establishment of a written effective respirator protection program as required by OSHA, DOD, and AF regulations (also ANSI Z22.8). Significant components of these standards include appropriate training of the users, fitting of the equipment, medical evaluations, and periodic maintenance and inspection of the equipment. The training and maintenance/inspection requirements vary in the degree of complexity based on the type of respiratory protection. For technically sophisticated equipment such as SCBAs, the user training and equipment inspections should be repeated frequently to ensure a state of readiness.

The highest level of protection is afforded by a supplied air respirator operated in the pressure-demand mode. The two most frequently used forms of supplied-air-respirator protection are the self-contained breathing apparatus and the airline respirator. Either of these types of equipment is suitable for Level A or B HAZMAT operations (and for unknown degrees of hazard). Although either respirator type offers equal protection factors, the SCBA is selected most frequently for HAZMAT incidents.

The SCBA offers a source of pure air without an airline attachment. While this is the major favorable characteristic of SCBA respirators, there are also negative factors associated with SCBA, including:

- a. weight of equipment (causing undue physical stress),
- b. restricted movement (due to bulk and weight),
- c. limited work cycle (air supply usually 30 minutes or less),
- d. equipment requires frequent technical inspection and maintenance, and
- e. operators must receive special training.

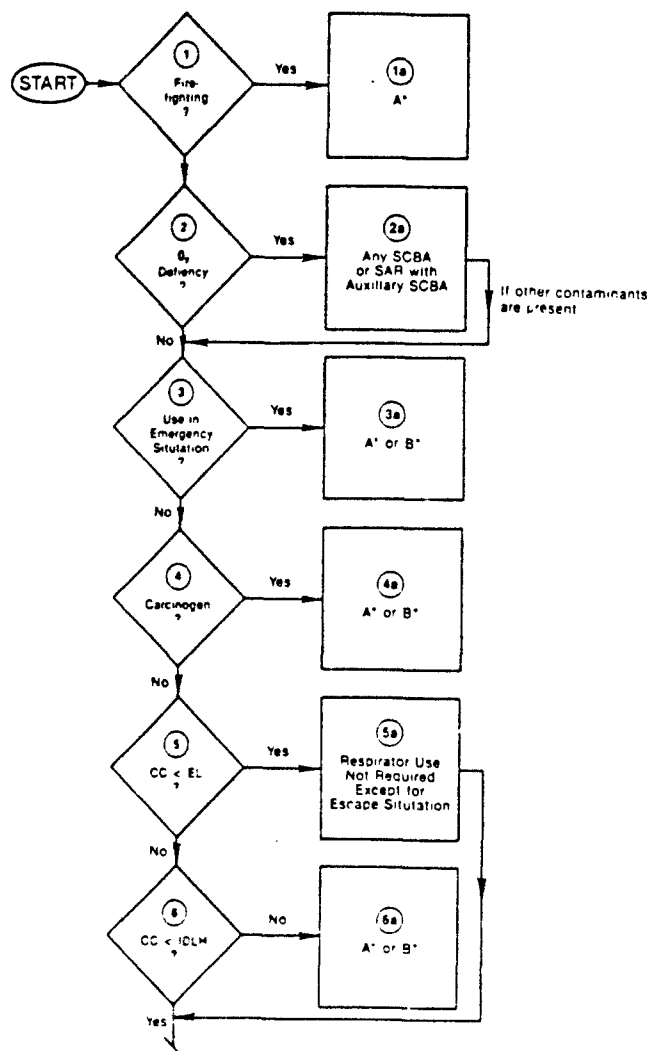
While use of an airline respirator provides a solution to some of the significant problems associated with the SCBA, the problems associated with its use usually render it unsuitable for HAZMAT response. While the airline respirator creates no limitation on the work cycle (i.e., no limits on amount of air supply) and the airline does not require the user to carry the air supply (added weight), it has an inherent restriction created by the air hose. This restriction significantly reduces its suitability on HAZMAT incidents. Airline hoses are limited in length (300 feet maximum), subject to contamination (and subsequent spreading of contamination), and the air supply system may require an unacceptable amount of time for setup.

For known Level C conditions, a properly selected air-purifying respirator may be utilized. To ensure effective protection, it is essential that the user must be fitted for the type of mask, the proper cartridge must be selected, and the limitations of the respirator must be fully considered. While the air-purifying respirator is highly effective for particulate hazards (if properly fitted and worn), protection from gases and vapors is not as certain. The use of air-purifying cartridges should be limited to those materials that possess good warning properties (odor thresholds lower than dangerous levels).

Selection of the appropriate respirator for the hazard is provided by a selection logic diagram (Figure 21).

9. Gloves

Gloves are the most thoroughly tested of all CPC items, and substantial data are available on the resistance to chemical permeation



KEY CC—Contaminant Concentration
EL—Exposure Limit
ESLI—End of Service Life Indicator
FF—Full Facepiece
IDLH—Immediately Dangerous
to Life or Health
PD—Pressure Demand
PF—Protection Factor
PFA—Assigned PF
PFmin—Minimum PF

PP—Positive Pressure
SCBA—Self-Contained
Breathing Apparatus
SAR—Supplied Air Respirator

A*—SCBA with FF operated in PD or PP mode
B*—Type C supplied air respirator (a) (ii) operated in PD or PP mode with auxiliary SCBA
C*—Escape respirator or gas mask with appropriate filter/sorbent (Subparagraph 5) if O₂ deficient then SCBA

Figure 21. Respirator Selection Logic Diagram.

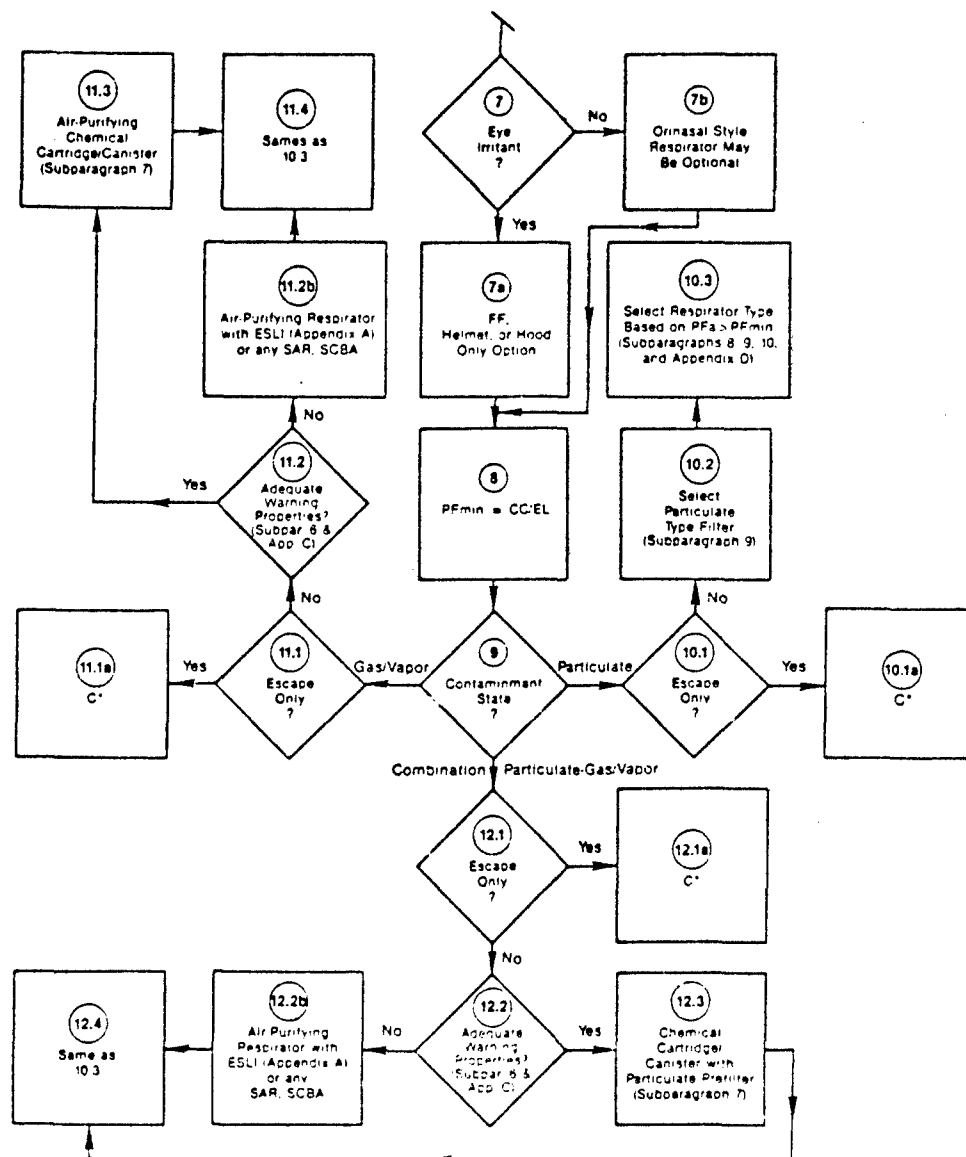


Figure 21. Respirator Selection Logic Diagram (Concluded).

by various materials (Reference 31-35). Gloves are often the weak link in CPC items because they are subjected to the greatest amount of physical stress (abrasion and tearing). A wide variety of natural and synthetic rubber and polymer materials are used to manufacture gloves. Numerous data bases are available that contain chemical-permeation-resistance information on the above materials. Gloves of the highest quality are worn in two layers in Level A and B environments, while all-purpose gloves can be used in Level C and D environments. For suits already integrated with gloves, another pair of gloves is used as the outer layer. Gloves must be chemically compatible with the spilled substance. Other points on which gloves are evaluated are flexibility, dexterity, puncture and abrasion resistance, gripping capabilities, whether or not they are seamless, and degree of thermal protection.

10. Footwear

Footwear, like gloves, must also perform in a physically demanding environment. A wide selection of materials of construction is available to provide protection against both chemical contamination and puncture. Footwear that meets the American National Standards Institute Z41.1, Z41.4, and Z41.5 safety specifications is recommended for maximum protection against puncture. Other safety components of footwear include nonskid soles, steel toes and soles, and comfort. It is recommended that footwear be integrated with totally encapsulated suits for maximum protection in Level A and B environments.

Seamless covers (pullover or snap-on) can be used as added protection for HAZMAT workers wearing lace-up type boots. Lace-up boots can be worn only in Level C and D environments. Both boots and covers can be coated with traction-enhancing materials for use in spills on smooth surfaces. Available footwear also includes snap-on foot guards constructed of plastic, aluminum, or steel.

11. Chemical Protective Clothing Regulations

The source for OSHA's 29 CFR 1910 standards that pertain to CPC are summarized in the following list:

CFR	ANSI
29 CFR 1910.132	ANSI Z41-1967 - General Requirements for Personal Protective Equipment
29 CFR 1910.133(a)	ANSI Z87.1-1968 - Eye and Face Protection
29 CFR 1910.134	ANSI Z88.2-1969 - Standard Practice for Respiratory Protection
29 CFR 1910.135	ANSI Z89.1-1969 - Safety Requirements for Industrial Head Protection
29 CFR 1910.136	ANSI Z41.1-1967 - Men's Safety Toe Footwear

12. HAZMAT Response Equipment

Remedial action at hazardous chemical spills generally proceeds through three phases: containment, cleanup and recovery, and disposal. Speed and correctness of actions of the initial HAZMAT response workers will have an indirect effect on each phase. In addition to CPC, initial HAZMAT personnel will require adequate equipment for spill control. High-quality, high performance spill control and cleanup equipment are required to minimize worker exposure and environmental damage. All equipment must be located in a specified area for rapid access and be readily transportable. Additionally, HAZMAT personnel should be well trained in the operation and application of all equipment.

a. Detection and monitoring

Primary airborne hazards routinely monitored during initial site entry and work in response to a HAZMAT event include:

- (1) flammability/explosivity
- (2) oxygen deficiency and
- (3) airborne toxic materials

Since the primary acute hazards associated with HAZMAT events are often those of fire and explosion, the use of an explosimeter is most often the first monitoring that is performed. The principle of operation and degree of sophistication of explosimeters varies. Essentially all commonly used explosimeters provide results in units of percentage of the lower flammable/explosive limit. Most explosimeters depend on the presence of adequate oxygen to ensure accurate readings; therefore, the user is commonly advised to evaluate oxygen levels before using an explosimeter. Additionally, these monitors are sensitive to a number of materials and may fail to operate correctly if they have been previously exposed to materials such as lead (basically any material that deactivates platinum catalysts will invalidate explosimeters). Finally, the explosimeter is accurate only below and into the flammable range for gases. If an environment is encountered that contains levels exceeding the flammable range (too rich a mixture), the meter will provide incorrectly low readings. Explosimeters are limited in that they do not indicate the presence of explosive dusts or mists; they indicate the presence of flammable gases and vapors only.

Direct monitoring for the presence of toxic gases and vapors may be performed to identify the material or to determine the amount of the material; that is, qualitative versus quantitative monitoring.

If too little information is available on the identity of the materials involved in the HAZMAT incident, a qualitative evaluation may be undertaken. It should be noted that this method of identification is generally inferior to positively identifying the materials by

using transporter logs and similar shipping information. Qualitative monitoring devices range from highly sophisticated devices, such as portable gas chromatographs and infrared analyzers, to relatively simple HAZMAT detector tube kits for decision-deductive reasoning schemes. While the sophisticated instruments can have the ability to perform accurate qualitative analysis, they are costly (\$15,000 up), require significant technical maintenance, and often require a highly trained individual to operate and interpret results.

The detector tube kits, which are now packaged in special assortment to allow for identification of unknown materials, are relatively low in initial cost, and the operator does not need as high a level of training as for the more technically sophisticated instruments. Both types of qualitative analysis have been shown to be effective.

Similarly, qualitative determination of air contaminants may be performed using a wide variety of types of equipment. The equipment used for quantitative analysis includes those types of instruments used for qualitative analysis as well as direct reading electronic devices, which have been developed in recent years and contain gas specific sensors. A less satisfactory method of quantitative evaluation is sample collection for subsequent laboratory analysis. The latter method is satisfactory only to document exposures after-the-fact.

Generally, the method of quantitative analysis is matched to those materials that will most likely be encountered (as previously discussed for CPC) and also matched to the level of operator expertise. Generally, the direct reading instruments and detector tubes are suitable for moderately trained individuals, while the use of portable gas chromatographs or infrared analyzers should be used by dedicated sampling professionals (e.g., industrial hygienists or field chemists).

b. Leak prevention and sealing

The best means of spill control is spill prevention. The structural integrity of all storage vessels and connecting transfer piping should undergo a regularly scheduled maintenance program. The above recommendation applies especially to underground storage tanks, because releases from these vessels are extremely difficult to detect and remedial action of soil contamination is extremely expensive.

Because USTs pose the greatest threat of a costly release and because Congress has recently passed stringent UST legislation, it is recommended that all chemical storage be above ground and existing USTs undergo excavation.

If a spill occurs, both chemical and mechanical measures are available for control or stoppage. Response actions for various types of spills have been summarized in Appendix J. Chemical methods work by forming a strong bond to the vessel surface and undergoing

solidification once exposed to air and the leaking substance. Bonding to the vessel surface is accomplished regardless of surface condition. In general, chemical methods are fast-acting and work on a wide variety of substances.

Chemical compatibility must be verified before use to avoid possible side reactions. Mechanical measures include sealing cushions and balloons. Balloons are either expanded by compressed air or water to seal piping, while cushions are placed over the leaking area and strapped around the vessel. Balloons are used on small openings, while cushions are used for large vessels.

An applicator gun used for application of a solidifying foam combines chemical and mechanical mechanisms. This equipment is reliable and easy to operate. However, it is necessary to know the compatibility between the foam and the leaking substance.

c. Communications

Two categories of communication are most important during a HAZMAT response activity. The primary level of communication is between those individuals entering the hazardous area and the base of operations for the HAZMAT site (in the field). The secondary level of communication is between the HAZMAT field location and the essential services (security, fire, hospital, etc.).

A variety of portable wireless communication devices are now available for the field responders. The most popular and convenient of these are the wireless headsets and radio units which are integral to safety equipment (hard hats).

While radio communication is still the most efficient and most often used communication device with essential services, there is also an increase in the use of computer telemetry and combination computer/radio communication. The primary advantage for the combination systems is gained through speed and efficiency of communication.

d. Soil cleanup

Spill cleanup should be considered during the initial phase of emergency responses, because response activities can greatly affect the cleanup. Spill cleanup can be initiated once the emergency situation has been brought under control, but may be greatly complicated by such actions as excessive use of water. Additionally, delays in remedial action of spills can result in increased complexity of cleanup operations, excessive environmental damage, and substantial increases in cleanup costs. These three points must be considered when formulating an initial response and remedial action plan. For emergency response, the use of spill removal and temporary storage equipment by HAZMAT personnel can greatly speed up the overall remedial action process. Spill cleanup by the HAZMAT emergency response team is generally limited to confined, isolated spills of limited quantities.

e. Soil removal

Spill removal equipment consists of pumps, booms, and skimmers. Each of these equipment types must be in good operating condition and readily transportable. HAZMAT personnel training in the operation, function, and limitations of all equipment types on a periodic basis is recommended for maximum utilization efficiency.

Pumps are needed for transferring three types of hazardous substances: regular, corrosive, and flammable liquids. Regular hazardous substances include slurries and contaminated water. However, the degree of contamination may warrant the use of other pumps. Regular pumps require no special construction materials and should be used as much as possible due to their relatively low cost when compared with that of more specialized pumps. Pump connections of the quick-disconnect type can be used for rapid availability.

Special pumps must be used for corrosive and flammable liquids, which are inorganic acids and bases. Pumps, along with special gaskets and seals used to transfer these chemicals, must be coated with a plastic-type material. Pumps for flammable liquids, which consist entirely of organics, require all rotational parts to be constructed of nonsparking materials.

HAZMAT personnel can use either hand- or foot-operated, air-driven, or electrical pumps. Manually operated pumps are used for small spills and where an air or electrical supply is unavailable. Larger spills require use of air-driven or electrical pumps. These last two pumps can also be used when HAZMAT personnel need to be at a remote location from a spill. All pumps can be equipped with quick-disconnect fittings for maximum availability. Depending on desired pumping capacities (i.e., pump size), pumps can either be hand-carried or transported by carrier vehicles.

Booms are used for floating spills and water-miscible spills and are used either to contain or to collect a spilled substance. Booms used to collect a spill are filled with solid sorbents. Sorbents used for this purpose must be water-repelling for maximum sorbent efficiency. Although different types of booms exist, HAZMAT personnel can best use rapid-deployment types. Booms can be reusable or disposable and are available in a variety of standard lengths.

Skimmers are used strictly for floating spills. Skimmers function by different mechanisms and vary in efficiency. Skimmers are difficult to decontaminate and are limited to working in low wind conditions. Of principal importance to HAZMAT workers is the fact that skimmers are capable of covering large spill areas with minimal worker attention.

f. Storage and disposal

The main purpose of chemical storage units is to provide a temporary means to store spilled substances for later remedial action. Storage units for hazardous substances must be portable and chemically compatible with all construction. Flexible units are swimming-pool-type containers, inflatable either by air or water. Floors of these containers are strengthened to be able to support leaking drums or small vessels. Flexible units can be designed to specifications of shape and volume. Materials of construction must be chemically compatible with the spilled substance. Portable, rigid units are nothing more than steel vessels mounted on a carrier. These units pose less problems than do flexible units. Rigid units rarely have chemical-compatibility problems, provide greater storage capacity, and can be easily outfitted with the necessary pumps and transfer piping.

Disposal operations may have to be performed by off-base contractors. These operations require the need for complex chemical treatment processes and experienced engineers and technicians. The critical role played by the initial HAZMAT response team in relation to the disposal of the spilled substance cannot be overemphasized. Onsite coordinators should consult with experienced waste treatment engineers on methods of emergency spill response to minimize disposal costs. Planning of potential spill scenarios will produce response plans that will greatly facilitate this effort.

g. Decontamination

All equipment and reusable clothing used by HAZMAT personnel must be decontaminated to prevent the spread of hazardous substances outside the spill area. The reader is referred to a joint agency publication prepared by NIOSH, OSHA, EPA, and the U.S. Coast Guard titled Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (Reference 19). This publication describes factors that influence the extent of contamination and methods for preventing or reducing contamination. It also provides general guidelines for designing and selecting decontamination procedures at a site and presents a decision aid for evaluating the health and safety aspects of decontamination methods.

h. Safety

Safety is a primary concern during emergency response. The most important safety equipment is chemical protective clothing. Detection and monitoring equipment enhance worker safety by providing data on the presence and concentration levels of hazardous chemicals. These devices are particularly important in warning HAZMAT personnel of sudden increases of hazardous chemicals in the working environment.

Other safety equipment includes waterproof flashlights, emergency lighting, first-aid and trauma kits, showers and eyewash stations, and nonsparking tools. Tools will include special types for opening drums, heavy-duty tanks, and, possibly, railroad cars.

Signs, barricades, flags, and similar equipment may also be needed to limit access of unauthorized individuals to the area.

If an incident involves confined spaces (e.g., a spill in a ravine or down a culvert), emergency retrieval equipment may be necessary. This type of equipment may include safety harnesses, lanyards, and portable ventilation.

13. HAZMAT Response Chemicals

Prevention is the best method of spill control. However, when a spill occurs and chemical treatment is needed, HAZMAT personnel need to know which chemicals to use and how to use them. Spill treatment chemicals serve to neutralize, contain, or increase the cleanup capabilities of a spilled substance. Chemicals used to treat spills include sorbents, foams, and specialized additives.

a. Chemical sorbents

Chemical sorbents are solid materials which function by absorbing a spilled substance. Sorbents are classified as either natural or synthetic. Natural sorbents include straw, sand, peat, clay, activated carbon, and silicates. Synthetic sorbents include polypropylene and polyethylene. Specialty sorbents, such as vermiculite, cellulosic, and polymeric are combinations of both types or are advanced formulations of a particular sorbent. Some sorbents will repel water while adsorbing the spilled substance.

Chemical sorbents have a wide range of efficiencies and costs. Sorbent efficiency is based on the absorption capacity per sorbent weight, with cost being directly proportional to efficiency. Natural sorbents are inefficient and are used solely because of their apparent low cost. Because they are inefficient, a lot of natural sorbent is required for any spill, which leads to high cleanup and disposal costs. Synthetic sorbents are very efficient in comparison to natural sorbents. This fact is illustrated in the following:

Sorbent	Lb of Absorbed Chemical/Lb of Sorbent
Clay 0.15	
Cellulosic	2.21
Vermiculite	4.00
Polymeric	9.60

For emergency response use, sorbents must be fast-acting and efficient. However, a problem for HAZMAT personnel with regard to sorbents is packaging. Some sorbents are packaged in bulky and heavy

containers and are difficult to handle for HAZMAT personnel during emergency conditions, particularly if workers are wearing FES.

Spill control technology has developed a relatively new product that challenges the use of more traditional solid sorbents. This product is known as absorbent socks and has gained wide acceptance in private industry. All parameters considered (ease of handling, purchase cost, absorption efficiency, and cleanup and disposal costs) absorbent socks are superior to both conventional and specialty sorbents. Three types of absorbent socks currently marketed are mineral, cellulosic, and polymeric.

Mineral socks are the least efficient and the most difficult to handle. Most of these socks use clay as a filler but some use vermiculite. Some hazardous substances (i.e., hydrofluoric acid and hydrazine) react with filler impurities, releasing heat and toxic gases. Chemical compatibility must be known to ensure the safety of HAZMAT personnel. Since mineral socks are not biodegradable, they may be disposed in an approved landfill.

Generally, cellulose socks are best because disposal can be accomplished by incineration. Fillers for these socks include cotton, sawdust, wood pulp, ground paper, and corncob centers. Land filling of these sorbents is not allowed because they are biodegradable. Biodegradation of these sorbents will result in the release of the absorbed substance into the soil and groundwater. However, if the absorbed substance is classified as nonhazardous under state law, then land filling is a viable disposal option. Cellulosic socks are not to be used on acid or caustic spills because cellulosic fibers are not chemically resistant to these substances.

Polymeric socks are chemically inert to almost any substance. Fillers most often used are polyethylene and polypropylene, but the most effective is TYVEK. Occasionally, cellulosic fibers are used as a co-filler. These socks are lightweight enough to handle for HAZMAT personnel wearing FES. Polymeric socks are nonbiodegradable, and land filling is the best method of disposal.

b. Foams

The primary reason for using foams on hazardous chemical spills is vapor suppression. Vapor suppression foams require a half-life of 2 to 3 days, so regular firefighting foams cannot be used for this purpose. Specialized foams are available for acid, caustic, and organic spills.

Foams used to control oil and some hydrocarbon spills cannot always be used for other hazardous spills. References are available that contain current information on the application of foams to HAZMAT spills (References 36-39).

The use of foams to control vapor emissions from hazardous chemical spills offers HAZMAT personnel important advantages. A small amount of foam can cover a large area due to its high-expansion capacity. Foams can be applied quickly (with the use of blowers), at a distance from a spill. Because of this fact, more time is available for response from support teams and decision-making by onsite coordinators. Together, these advantages reduce the possibility of worker exposure and reduces the transport of hazardous vapors and gases to nearby communities.

c. Specialized additives

Neutralizing agents are needed to reduce the corrosiveness of acid or caustic spills, particularly when the spill is a strong (i.e., highly corrosive) acid or base. HAZMAT personnel must exercise caution when adding these chemicals to a spill due to the violent reaction and amount of heat released upon mixing. Water can be added to reduce this effect and, in some cases, may be the only necessary treatment. Neutralizing agents should not be used on organic spills because of the possibility of violent side reactions and the subsequent release of toxic gases.

Jelling agents will immobilize a spill by solidification. Because many jelling agents are solids, they are considered in the same context as solid sorbents in terms of cleanup and disposal costs. Jelling agents are best utilized for land spills, which can absorb rapidly into the ground or flow into nearby streams. A special class of jelling agents are elastomers, which by thickening, increase the elasticity of organics. This thickening action increases the capability of separating organics from spills on water. Dispersants also facilitate the separation of organics and water by lowering surface tension between the two. Caution is advised when using dispersants as some are toxic to humans.

L. NATIONAL STOCK NUMBERS FOR EQUIPMENT, MATERIALS, AND CLOTHING FOR HAZMAT INCIDENTS

NSNs are assigned to materials by the Defense Logistics Agency, which is located in Battle Creek, Michigan. An NSN may be assigned only upon the request of the AF. A vendor part number and/or material specifications must be provided when an NSN assignment is requested.

Materials provided by the U.S. AF fire department as "changes to TA 490" and "additions to TA 016" were checked for NSN assignments by the Defense Logistics Agency.* Of the 55 items listed, only four items had been assigned NSNs as follows:

*Floyd, E., and E. Trotter, 1988. Defense Logistics Agency, personal communication with G. D. Smith, ORNL.

NSN	Material Description
4240-01-274-0461	SCBA manufactured by MSA
8120-01-007-0258	Emergency repair kit manufactured by Indian Springs Mfg. Co.
6640-01- 236-6424	Portable eye/face wash manufactured by Fendall Co.
6665-00-255-1386	Universal test kit gas with pyrolizer manufac- tured by MSA

Additional CPC, equipment, and chemicals that may be needed for HAZMAT incident response are listed in Appendix B. The CPC in Appendix B is listed by levels of protection.

Appendix K contains a list of vendors with the HAZMAT equipment, materials, and chemicals handled by each vendor. This is not an all inclusive list nor is it intended as a recommendation or endorsement.

M. MUTUAL AID REQUIREMENTS AND RESPONSE AGENCY ACTIONS

1. Federal Regulations that Pertain to HAZMAT Contingency Requirements

a. The Superfund Amendments and Reauthorization Act of 1986, SARA, PL 99-499.

Mutual aid agreements are now an important part of emergency response plans required by Title III of SARA. Title III, the Emergency Planning and Community Right-To-Know of 1986, mandates efforts to establish effective emergency planning programs. It is a free-standing title that establishes four major authorities relating to:

- (1) emergency planning,
- (2) emergency notification,
- (3) reporting to the public on chemicals, and
- (4) emissions inventories.

States are required to establish a state emergency response commission, emergency planning districts, and local emergency planning committees to develop and facilitate the implementation of emergency response plans for those facilities where extremely hazardous substances are present.

The local emergency planning committees include representatives from the following groups: state and local elected officials; law enforcement, civil defense, firefighting, first aid, health, local environmental, hospital, and transportation, broadcast and print media, community groups, and owners and operators of facilities subject to this title. The purpose of such plans is to prepare state and local responses to releases of chemicals. Each committee is to evaluate the "need for resources necessary to develop, implement, and exercise the emergency plan, and shall make recommendations with respect to additional resources that may be required and the means for providing such additional resources" [PL 99-499, Section 303(b)]. Each local emergency planning committee is to complete an emergency plan by 17 October 1988. The committee is then to review the plan once a year or more frequently, if circumstances require. The statute specifies a number of components for these plans which include the following:

(1) Identification of facilities within the emergency planning district, identification of transport routes, and identification of additional facilities contributing or subjected to additional risk due to their proximity to facilities subject to the requirements of Title III, such as hospitals or natural gas facilities.

(2) Methods and procedures to be followed by facility owners and operators and local emergency and medical personnel to respond to any release.

(3) Designation of a community emergency and facility emergency coordinators who shall make determinations necessary to implement the plan.

(4) Procedures to provide reliable, effective, and timely notification by the facility emergency coordinators and the community emergency coordinators to persons designated in the emergency plan and to the public of a release.

(5) Methods for determining occurrence of a release in the area or of a population likely to be affected by such release.

(6) A description of emergency equipment and facilities in the community and, at each facility in the community, an identification of the persons responsible for such equipment and facilities.

(7) Evacuation plans, including provisions for a precautionary evacuation and alternative routes.

(8) Training programs, including schedules for training of local emergency response and medical personnel.

(9) Methods and schedules for testing the emergency plan [PL 99-499, Section 303(c)].

Owners or operators of facilities are required to notify community emergency coordinators of local committees and the state commissions in the event of a chemical release if the amount released exceeds the reportable quantity (refer to PL 99499, Section 304(a) for types of releases and reportable quantities). Notice can be given by telephone, radio, or in person. If the release involves transportation of a substance or storage after such transportation, the notice requirements can be satisfied by dialing 911, or in the absence of a 911 emergency telephone number, the operator [PL 99-499, Section 304(b)1].

b. The Comprehensive Environmental Response, Compensation, and Liability Act CERCLA PL 96-410

The purpose of CERCLA's National Oil and Hazardous Substances Pollution Contingency Plan, which addresses hazardous substance response, is to "effectuate the response powers and responsibilities created by CERCLA and the authorities established by Section 311 of the CWA, as amended" (40 CFR Section 300.1). The plan applies to all federal agencies.

The National Contingency Plan (NCP) is the blueprint for cleanup and remedial action under CERCLA. EPA originally developed the NCP under Section 311 of the CWA. Subpart F of the NCP is the National Hazardous Substance Response Plan. It establishes the procedures and standards for responding to releases of hazardous substances, pollutants, and contaminants. Essentially all releases of pollutants to the air, land, and water are potentially subject to the NCP unless excluded by law. Subpart F is divided into seven phases. Most of the subpart applies to fund-financed responses, but many of the requirements also apply to cleanup by responsible parties (40 CFR 300.71). The 1986 Amendments contain a number of new requirements for the NCP, which is due to be revised to reflect the new cleanup standards and public participation provisions contained in SARA.

c. The Resource Recovery and Conservation Act (RCRA, PL 94-580)

Regulations for preparedness and prevention were also promulgated by EPA in RCRA and can be found in 40 CFR 264.30-264.49 and 265.30-265.49. The purpose of these regulations was to minimize the possibility and effect of an explosion, spill, or fire. This purpose was not unlike that of SARA but addressed hazardous wastes as opposed to hazardous materials which were addressed in SARA. Facilities subject to these regulations are RCRA transportation, storage, or disposal (TSD) facilities. Subject facilities are required to have the following equipment:

*CERCLA Section 105. The original NCP was set forth at 40 CFR Part 1510 and related primarily to discharge of oil and hazardous substances that affect or may affect the navigable waters. The new NCP is codified at 40 CFR Part 300.

- (1) an internal alarm or communications system;
- (2) a device capable of summoning emergency assistance from local agencies;
- (3) fire and spill control equipment; and
- (4) decontamination equipment.

The regulations also require that equipment be maintained in proper operating condition, be tested routinely, and that adequate aisle space be provided to allow unrestricted movement of emergency equipment to any area of the facility.

Operators of TSD facilities must attempt to make arrangements with local authorities, such as police and fire departments to familiarize them with the layout of the facility, the properties of hazardous wastes handled there, and places where facility personnel would normally be working (40 CFR 264.37, 265.37). Local hospitals should also be informed of the properties of the hazardous wastes handled at the facility and the types of injuries or illnesses that could result from a fire, explosion, or accidental release. If state or local authorities decline to enter into such arrangements, the TSD facility operator must document their refusal in the operating records of the facility. An operator's preparedness and prevention plan must be submitted with the Part B permit application and thus becomes part of the final RCRA permit.

Arrangements with local authorities are to be "appropriate" for the type of hazardous wastes handled at the particular facility. Showing EPA that the "appropriate" arrangements have been made may not be easy in some cases, depending on the range of hazardous wastes handled at each AF base. Complying with this requirement may also entail coordination of AF policies under the OSHA, state occupational safety laws, and labor relations policies (where those may exist).

Operators are required to have a contingency plan for the facility designed to minimize hazards to human health and the environment in the event of an actual explosion, fire, or unplanned release of hazardous wastes (40 CFR 264.50-264.56 and 265.50-265.56). The contingency plans a prepared set of responses to an emergency. It should list the TSD facility's personnel who will serve as emergency coordinators and the emergency equipment that will be available. If an evacuation could prove necessary for the facility, an evacuation plan must be included. The plan must describe the arrangements agreed to by the local police and other government officials pursuant to the preparedness and prevention requirements discussed above.

Copies of the plan must be maintained at the facility and submitted to all local government units that might be called upon in an emergency. The plan must also be available to EPA personnel during on-site inspections and must be submitted as part of the facility's Part B

permit application. If the facility already has a SPCC plan, which is required under the CWA, Section 112, the SPCC plan can simply be amended to incorporate hazardous waste provisions.

The contingency plan must be implemented whenever there is a fire, explosion, or release of hazardous wastes that could threaten human health or the environment [40 CFR 264.51(b) and 265.51(b)]. An employee of the facility designated as Emergency Coordinator must be on call at all times to coordinate implementation of the contingency plan in the event of an emergency. The Emergency Coordinator must file a written report with the EPA Regional Administrator within 15 days after any incident that requires implementation of the plan (40 CFR 254.56). Federal regulations that pertain to contingency requirements are shown in the following:

FEDERAL REGULATIONS THAT PERTAIN TO CONTINGENCY REQUIREMENTS

1. The Superfund Amendments and Reauthorization Act of 1986 (SARA), P.L. 99-499. Title III (The Emergency Planning and Community Right-To-Know Act of 1986), Sections 302-403.
2. The Clean Water Act, P.L. 92-500. 40 CFR Part 112.
3. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), P.L. 96-410. 40 CFR Part 300 - National Oil and Hazardous Substances Pollution Contingency Plan, Subpart F - Hazardous Substance Response, Sections 300.61-300.71.
4. The Resource Conservation and Recovery Act (RCRA), P.L. 94-580. 40 CFR Parts 264 and 265 - Standards and Interim Status Standards for Owners and Operators Of Hazardous Waste Treatment, Storage, and Disposal Facilities, Subpart C-Preparedness and Prevention and Subpart D - Contingency Plan and Emergency Procedures, Sections 264.30-264.56 and 265.30-265.56.

2. Air Force Regulations Pertaining to HAZMAT Contingency Requirements

It is generally stated that it is AF policy to "develop contingency plans and procedures for dealing with accidental pollution incidents" (AFR 19-1). Each installation is to prepare contingency plans and procedures in accordance with the USAF Oil and Hazardous Substance Pollution Contingency Plan (OHSPC) (AFR 19-8). Plans for prevention of spills are to be developed within EPA jurisdiction and in accordance with Attachment 2 of AFR 19-5. According to Air Force regulations, the Spill Prevention, Control, and Countermeasures Plan,

which is required by the Clean Water Act [CWA, Section 311(b)(2)] is to be added as an annex to the OHSPC Plan (AFR 19-1 1978b). The OHSPC Plan and SPCC Plan are to be "reviewed and updated annually or within 6 months after a change occurs . . ." (AFR 19-1 1978b).

Each base is also required to develop an emergency action plan to reduce air emissions from their facilities during air pollution episodes (AFR 19-1 1978b). The plan is to conform to the CAA. The plan is to include "actions to be taken during each stage of the host state's or local governing agency's alert warning system (Air Pollution Episode plan)" (AFR 19-1 1978b).

Air Force regulations that pertain to contingency requirements are shown in the following:

AIR FORCE REGULATIONS THAT PERTAIN TO CONTINGENCY REQUIREMENTS

1. AFR 92-1, Civil Engineering - Fire Protection Program. Chapter 11 - Mutual Aid and Emergency Responses. November 19, 1981.
2. AFR 19-8, USAF Oil and Hazardous Substance Pollution Contingency Plan (OHSPC).
3. AFP 19-5, Environmental Protection - Environmental Quality Control Handbook. Attachment 2 - Guidance for Preparing SPCC Plan. October 15, 1975.
4. AFR 19-1, Environmental Protection - Pollution Abatement and Environmental Quality. January 9, 1978. TAC Supplement 1, July 21, 1978.
5. AFR 355-1, Disaster Preparedness - Planning and Operations.

3. Mutual Aid Requirements for Contingency Agreements

As mentioned earlier, new requirements in the Emergency Planning and Community Right-To-Know Act of 1986 may affect future agreements and Air Force regulations but, presently requirements for mutual aid agreements are found in Appendix L (AFR 92-1, Civil Engineering - Fire Protection Program, chapter 11 - Mutual Aid and Emergency Response). Generally, at least one of five situations must exist to justify such an agreement. A reciprocal agreement may be entered "to aid in fire protection for property usually protected by the installation fire protection organization" if at least one of the following five situations exist:

- a. Available AF fire protection is not adequate.
- b. The fire organization with which the agreement is to be made can furnish one or more pieces of staffed fire apparatus when there is no emergency in the area protected by that organization.

c. The fire organization could respond to calls under the agreement by having apparatus at the installation or requested location no more than 30 minutes after being notified, or the fire organization has special purpose apparatus that may be needed between notification and arrival at the scene.

d. The fire apparatus made available to the Air Force is of adequate standards in hose-laying, pumping capability, and appliances.

e. It is in the best interest of the USAF (AFR 92-1 1981, p. 11-44).

Agreements entered with a foreign country are to be in the exact format of Form 1 in Appendix L. When these agreements are negotiated, AFR 11-21 applies (AFR 92-1 1981). For agreements within the "United States, any state, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Trust Territory of the Pacific Islands, and any other territory or possession of the United States," the form in Appendix L must be used (AFR 92-1 1981).

The commander for the Secretary of the Air Force must execute all agreements. An "authorized representative of the fire organization or commissioners" must also be "a party to the agreement" (AFR 92-1 1981). Deviations from the formats presented in Appendix I must be approved by the MAJCOM and headquarters AFESC/DEF. Agreements are to be reviewed every 2 years and updated as required. Date of the most recent review and update is to be recorded and kept by the fire chief.

For emergency assistance at joint-use civil airports, reciprocal agreements may be entered into if at least one of the previously mentioned five conditions exist. Directives for negotiating such agreements are outlined in AFR 92-1, Chapter 11, Section A. Essentially, the value of AF emergency capabilities (including equipment and personnel) are to be considered when negotiating the financial aspects of joint-use agreements. These agreements, however, "will not commit the AF to provide any specific level of firefighting capability, and will not contain detailed provisions concerning firefighting activities" (AFR 92-1 1981). It is further suggested, in AFR 92-1, that the joint-use agreement provide that amounts to be paid by the airport operator, or credited to cost-sharing for the AF emergency capability, be subject to renegotiation if the AF makes "significant changes in the resources assigned to the airport." When owners or operators of civil aircraft request assistance, they are to be charged for all expenses incurred by the AF.

A release and indemnification clause must be included in the joint-use agreement if the AF is called on to furnish firefighting services at a joint-use civil airport. Refer to Appendix L for the format to be used.

According to AFR 19-1, Section B, Headquarters USAF Responsibilities: the Judge Advocate General, through its field organization, is to review for legal adequacy all plans and programs developed to meet environmental protection statutes. Therefore, as additionally specified in AFR 92-1, Chapter 11 written documents stating procedures to be followed at joint-use airports must be coordinated with the Base Staff Judge Advocate. A copy of each document must also be sent to "the MAJCOM fire protection function, with an information copy to Headquarters AFESC/DEF" (AFR 92-1 1981).

The DOD and EPA entered into a memorandum of understanding (MOU)* to "clarify each Agency's responsibilities and commitments for conducting and financing response actions authorized by CERCLA. Section 104 of CERCLA places authority for responding to releases from DOD facilities with the Secretary of Defense. As mentioned earlier, these response actions must be conducted in accordance with the NCP, as amended by EPA under Section 105 of CERCLA.

Section 8 of the MOU addresses multiparty agreements. The MOU states that DOD installations may enter agreements with state and local authorities regarding response actions but that such agreements must be "consistent with this agreement [the MOU], except that dispute resolution sections of such agreements may supersede Section 7 of this MOU."

Regulations that govern mutual aid agreements are: AFR 92-1, Civil Engineering - Fire Protection Program. Chapter 11 - Mutual Aid and Emergency Responses. 19 November 1981; Memorandum of Understanding between the Department of Defense and the Environmental Protection Agency for the Implementation of PL 96-510, CERCLA of 1980. August 12, 1983; AFR 19 1, Environmental Protection - Pollution Abatement and Environmental Quality. 9 January 1978; AFR 11-21, International agreements.

4. Response Agency Actions Pertaining to Initiation and Participation in Mutual Aid Agreements

Response actions within the United States are initiated on the request of a representative of the "fire organization" or installation's fire department to a representative of the other, whichever is in need of assistance. Equipment and personnel are then to be dispatched to the point designated by the party requesting assistance.

Participation in an agreement is subject to the conditions of the agreement. For example, for response within the United States as outlined in form 2 in Appendix I, dispatch of equipment and personnel are subject to the following conditions:

*MOU between the DOD and the EPA for the implementation of CERCLA (PL 96-510), 1983.

a. Any request for aid must specify (a) the amount and type of equipment and personnel requested and (b) the location to which they are to be dispatched, but what is to be furnished will be determined by "a representative of the responding organization."

b. The responding organization is to report to the officer-in-charge of the requesting organization and is subject to the orders of that official.

c. The responding organizations will be dismissed when their services are no longer required or when they are needed within the area for which they normally provide protection.

d. The fire department chief or representative may assume full command for an incident involving the crash of aircraft owned or operated by the United States or military aircraft of a foreign nation if the incident takes place within the area for which protection is normally provided (AFK 92-1, 1983).

For response actions involving participation in mutual aid agreements with foreign nations, refer to Form 2 in Appendix I.

SECTION IV

AIR FORCE HAZARDOUS MATERIALS RESPONSE TRAINING NEEDS FOR FIRE PROTECTION PERSONNEL

A. INTRODUCTION

1. Laws and Regulations

This section takes the view that an AF base is a Hazardous Waste Generator and has a Hazardous Waste Storage Facility. As such, by the Executive Order 12088 a base must comply with EPA regulations promulgated in 40 CFR. The first of these is 40 CFR 265.16, which dictates that facility personnel must complete a program of classroom instruction or on-the-job training that ensures facility compliance. This training must be directed by a person trained in hazardous waste management procedures and must include instruction for facility personnel on hazardous waste management procedures, including contingency plan implementation, relevant to the positions they will be working in. The training must ensure that personnel will be able to respond effectively to emergencies by familiarizing them with emergency procedures, equipment, and systems. Newly arrived personnel may not work unsupervised until they have completed the training. All personnel must review the training annually. The facility must maintain training records, job descriptions and titles, and names of personnel assigned to each position.

Regulation 40 CFR 265.50 to 265.56, covering emergency plans and procedures, is also relevant. First, a contingency plan must minimize hazards to human health or the environment from fires, explosions, or unplanned releases of hazardous substances. The plan must specify the actions that the facility personnel must take in carrying out that action. The provisions of the plan must be carried out immediately whenever such events occur. By logical extension, for personnel to be able to immediately act they must have been trained to do so.

More explicit in its requirements for HAZMAT responder training is 29 CFR 1910.120 (OSHA), which explicitly includes HAZMAT responders under its provisions. Paragraph (b) states that initial, refresher, or review training must be given personnel before they are allowed to engage in hazardous waste operations. This training must meet the provisions of paragraph (e), which specifically addresses training. It requires training in the names of personnel and alternates responsible for site safety and health; safety, health, and other hazards on the site; use of personal protective equipment; work practices by which the employee can minimize risks from hazards; medical surveillance requirements including recognition of symptoms and signs that might indicate overexposure to hazards; site control measures; decontamination procedures; site standard operating procedures; contingency plan and implementation; and confined space entry procedures.

The required elements of the emergency response plan (in which responders must be trained) are preemergency planning; personnel roles; lines of authority, training, and communication; emergency recognition and prevention; safe distances and places of refuge; site security and control; evacuation routes and procedures; decontamination; emergency medical treatment and first aid; emergency alerting and response procedures; critique of response and followup; and personal protective equipment and emergency equipment. Also required for procedures for handling onsite emergency incidents are site topography, layout, and prevailing weather conditions; and procedures for reporting incidents to local, state, and federal governmental agencies. Further, onsite emergency response plans must be rehearsed regularly as part of the overall training program for site operations.

At the time of job assignment, all personnel must receive at least 40 hours of initial instruction off the site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. It also requires that workers exposed to unique or special hazards receive additional training and that the level of training shall be consistent with the employee's job function and responsibilities. Supervisors must have received at least an additional 8 hours on managing hazardous operations, and trainers must have been trained to a level higher than that which they are training. Employees and supervisors are to be certified by their instructors as having completed the necessary training.

This section also specifies at least 8 hours of refresher training a year. However, this requirement is far less than that required under SARA of 1986, Title III, which requires 24 hours of training annually for all responders. This requirement was published under 29 CFR (July of 1988 by OSHA).

The requirements for training are still evolving. Congress has directed OSHA to specify the content of training and establish a process for certifying and approving HAZMAT emergency response team trainers. OSHA was expected to have begun work to meet this mandate in late summer of 1988. Beyond the legal requirements for training, however, are some pragmatic and ethical considerations. Ethically, it is inarguable that a person should not be directed to perform a hazardous task without proper instruction. Pragmatically, it is expensive to train a firefighter but more expensive to replace him if he is incapacitated in the line of duty. Further, if the firefighter is not adequately trained in hazard mitigation and control, that mission may be jeopardized.

2. Overview of this Section

Training needs for AF HAZMAT response personnel (and for all firefighters as related to HAZMATs) are presented in this section in the form of task listings for the levels of response training that have been identified for AF firefighters. These listings are primarily HAZMAT-only tasks; tasks for fighting fires and other fire protection activities have been omitted. Sources of training are followed by

certification standards. In drawing up a training program, both task listings and certification standards should be consulted for content. The listing which follows is based on AF training now available; the NFPA's proposed standards for HAZMAT responders; Phoenix, Arizona, standard operating procedures; State of Oregon certification standards; State of Arizona certification standards; various journal articles and books; various AF operations plans and standard operating procedures; and interviews with AF and civilian HAZMAT experts.

Responsibility for decontamination may or may not be assigned to the fire department. Because a basic knowledge of decontamination is needed by anyone participating, including those to be decontaminated, and because responsibility for decontamination might be assigned to the fire department, training requirements are addressed in this section as if decontamination had already been assigned to the fire department. If this does not happen, training requirements should be adjusted accordingly. At a bare minimum, however, entry team members should be trained in how to go through the decontamination process, and personnel at the entry team leader or higher levels should be trained to take over from the Decontamination Officer if he or she is incapacitated. In addition to providing backup support to the Decontamination Officer, this would provide for independent evaluation of the appropriateness of the chosen decontamination strategy whether it is being done correctly and whether it is effective.

B. MINIMUM TRAINING REQUIREMENTS FOR FIREFIGHTERS FOR HAZMAT RESPONSE

1. Levels of HAZMAT Response Training

The NFPA recognizes four levels of HAZMAT training. They are First Responder, Awareness (FRA) Level; First Responder, Operational (FRO) Level; Hazardous Materials Technician (HMT) Level; and Hazardous Materials Specialist (HMS) Level. As these are the emerging standards by which most HAZMAT responders in the United States and Canada are likely to be certified, they will also be the levels of training which this report will use for conceptual breakpoints. For clarity, each level of training will be discussed with tasks generic to that level. A broad definition of each level of training follows:

a. First Responder, Awareness Level: Understand, recognize, and identify HAZMATs and obtain additional resources when faced with a HAZMAT incident.

b. First Responder, Operational Level: Detect and identify HAZMATs, and perform basic technical operations, such as reconnaissance, containment, stabilization, and decontamination under supervision.

c. Hazardous Materials Technician Level: Safely handle the technical aspects of a HAZMAT incident from initial response to cleanup and perform entry team leadership responsibilities and information coordination tasks.

d. Hazardous Materials Specialist Level: Direct all the activities of a HAZMAT incident response team and perform planning, training, and certification tasks.

There are several levels of hierarchy in the HAZMAT environment, and some of these rest within the levels of competency proposed by the NFPA. Positions in the FRO level include members of the reconnaissance team, decontamination team, backup team and entry team. Positions within HMT category include FCCO, RECON officer, DECON officer, and entry team leader. Positions within the HMS competency include the SFO (as OSC), HAZMAT incident response team leader, team safety officer, and trainer. It is not the intent of this analysis to carefully define each subtask and procedure but rather to define tasks closely enough to serve as a framework for developing a comprehensive training program outline. Detailed task analysis is left to the person(s) developing or adopting training programs.

All response team personnel will not necessarily be fire department operatives. Some may come from Operations, Directorate of Distribution, Directorate of Maintenance, Security Police, or hospital, as well as other offices. Regardless of where the personnel come from, all must be trained at least to the level at which they are operating. Further, the fire department cannot assume ready availability of all outside support persons nor that it will in every case be necessary to call them in. Thus, they should have personnel appropriately trained to perform the functions of these support people, at least on a level sufficient to handle "routine emergencies." Levels of training are as presented below.

2. First Responder, Awareness (FRA) Level

All entry-level firefighters should be trained at least to this level. They are the personnel who are likely to happen upon a HAZMAT, and the ability to recognize it and respond appropriately is critical. Normally, the FRA person will be under the direction of an SFO who is an HMS. The FRA must be trained to perform the following tasks:

a. Initiate response

(1) Assess fire site for HAZMAT

- Approach the site in a safe manner
- Recognize the presence of a HAZMAT incident

(Obtain information from shipper, handler, or person reporting the incident)

(Use container shapes, markings, colors, shipping papers, placards, labels, and senses)

- Assess immediate hazard to people and property
- Gather and record field information regarding the incident
- Determine whether immediate evacuation is required
- Inform SFO of all findings

(2) Alert and activate response system. As directed by the SFO:

- Alert pertinent components of the fire department HAZMAT incident response team
- Call for additional assistance
- Notify emergency response team responsible for first aid if people have been hurt
- Inform response team of the preliminary assessments of the incident

b. Initiate site action and control

- (1) Evacuate, if necessary, including rescue of personnel
- (2) Isolate the area
 - Set up barriers
 - Isolate single floors or areas of a building
 - Use security police to establish a perimeter
- (3) Control access
 - Use staging area to admit only fire, rescue, and emergency medical service personnel and vehicles
 - Position apparatus and personnel in a safe, temporary location until specific assignments are made

c. Identify the HAZMAT

- (1) Use binoculars to identify the HAZMAT from a safe distance
- (2) Use specific information to identify the hazard

Identify and classify the HAZMAT involved using marking, placards, labels, shipping papers, occupancy or location, container shapes, or personal contacts

Identify basic HAZMAT containers

(3) Identify the state the HAZMAT is in (gas, solid, liquid, high or low pressure)

(4) Identify the chemical and physical properties of the HAZMAT

- Determine type of HAZMAT (chemical, biological, radioactive)

- Determine class of HAZMAT (Class A Explosive, Class B Explosive, Class C Explosive, Blasting Agent, Flammable Gas, Non-flammable Gas, Cryogenic Gas, Flammable Liquid, Pyrophoric Liquid, Combustible Liquid, Flammable Solid, Water Reactive Solid, Spontaneously Combustible Solid, Oxidizer, Organic Peroxide, Poison A, Poison B, Irritant, Etiological Agent, Radioactive Material, Corrosive Material, ORM A, B, C, D, or E)

- Determine flashpoint

- Determine ignition temperature

- Determine water solubility

- Determine flammability

- Determine specific gravity/density

- Determine vapor density

- Determine boiling/vaporization point

(5) Use handbooks and CHEMTREC* to identify materials, properties, and hazards

(6) Identify how the environment is affecting the spill (heat, cold, rain, wind, hills)

(7) Identify what is causing the spill (leak, vaporizing gas, etc.)

d. Assess risk

(1) Determine possible risks to people, property, and environment from HAZMAT

*CHEMTREC telephone 1-800-424-9300.

(2) Estimate likely harm without intervention

e. Communicate to persons with authority - as directed by the SFO:

(1) Report data taken describing the incident to members of the HAZMAT incident response team with greater levels of expertise

(2) Request additional resources for handling the incident

f. Monitor personnel for signs and symptoms of exposure

(1) Observe self and other personnel for general signs and symptoms of exposure and for signs and symptoms of identified hazards

(2) Notify SFO or designated personnel of findings

g. Perform basic containment and control operations in Level I Responses (Levels are identified in Section III, Table 4).

(1) Don and operate in basic protection gear

(2) Perform basic physical mitigation procedures for Level I hazards

(3) Perform basic chemical mitigation procedures for Level I hazards.

(4) Perform basic decontamination procedures for Level I hazards (eg., detergent scrub)

3. First Responder, Operational (FRO) Level

FRO level personnel are those who actually enter the warm and hot zones and carry out operational roles. They perform the reconnaissance, fight the fires in the controlled zone, contain/control the HAZMAT, carry out rescues, perform decontamination, act as backup to the primary entry team, and provide fire protection support services during the final site cleanup. The FRO must be trained to perform the tasks listed below. Some of their functions are duplication of the FRA task listing. Where this is the case, only the major task domain is identified, plus the tasks and subtasks unique to FRO. These sections are cross-referenced to FRA (in parentheses), a pattern which will be followed throughout the task listing.

a. Initiate response (FRA, a.)

(1) Assess fire site for HAZMAT [FRA, a.(1)]

(2) Alert and activate response system [FRA, a.(2)]

- (3) Establish control zones; areas of responder control
 - Establish a hot zone
 - Establish a warm zone
 - Establish a cold zone
- b. Initiate site management and control (FRA, b.)
- c. Identify the HAZMAT (FRA, c.)
 - (1) Identify the HAZMAT from a safe distance [FRA, c,(1)]
 - (2) Use specific information to identify the HAZMAT [FRA, (2)]
 - (3) Implement safety precautions
 - Determine required protective clothing
 - Inspect protective clothing
 - Don protective clothing or assist entry team in donning protective clothing
 - Inspect entry personnel for proper protective clothing and fit
 - Ascertain permitted stay in hot zone
 - Ascertain signs and symptoms of exposure
 - (4) Approach the scene
 - Assemble in staging area
 - Maintain communication with team leader and team members
 - Monitor risk and hazard of situation; maintain awareness of response situation
 - Exclude nonauthorized personnel from site
 - Monitor themselves and others for signs and symptoms of exposure
 - Monitor equipment for degradation

- stay
 - Monitor time in zone and exit at end of permitted
 - Rescue entry personnel, as required
 - Conform to decontamination procedures
- (5) Size up the site
 - Determine wind direction
 - Determine terrain
 - Determine obstacles and barriers
 - Determine site hazards (power lines down, fire, smoke, etc.)
- (6) Identify the state the HAZMAT is in [FRA, c,(3)]
- (7) Identify the chemical and physical properties of the HAZMAT [FRA, c, (4)]
- (8) Use handbooks and databases to identify materials, properties and hazards [FRA, c,(5)]
- (9) Identify how the environment is affecting the HAZMAT [FRA, c,(6)]
- (10) Identify what is causing the spill [FRA, c,(7)]
- (11) Identify dispersion media, dispersion pattern, rate and quantity of release
- (12) Use radio to pass information and seek advice from experts
- d. Assess risk (FRA, d)
- e. Communicate to persons with authority (FRA, e.)
 - (1) Report data taken [FRA, e,(1)]
 - (2) Request additional resources [FRA, e,(2)]
 - (3) Aid in coordination between various agencies at the scene of the incident as directed

f. Perform HAZMAT control/containment and stabilization

(1) Organize for Containment Operations

- Assemble in staging area
- Ascertain the best initial approach to controlling the incident
- Select appropriate tools for containing/controlling the spill (plugging materials, dirt, shovels, tarps, etc.)

(2) Perform physical mitigation procedures

- Perform absorptions procedures using sand, clay, charcoal, or polyolefin fibers
- Perform dilution procedures, applying water to water-miscible HAZMATs to reduce them to safe levels
- Perform diking/damming operations using earth, concrete, or portable barriers
- Perform diversion actions to change direction of the flow of HAZMATs
- Perform dispersion actions, using water spray to disperse vaporous gas
- Perform overpacking actions which place faulty container or loose material in larger container
- Perform plugging and patching actions to stop leakage from present container
- Transfer material from at-risk container to safer container
- Suppress vapors by covering spilled material or spraying material to knock down vapors
- Perform venting operations to release a dispersable material
- Perform controlled burning to let HAZMAT fire burn itself out
- Perform flaring operation; control-burning the HAZMAT in order to reduce or control pressure
- Vent and burn the HAZMAT; use shaped charges to vent pressure, then release and burn remaining material

(3) Perform chemical mitigation procedures

- Adsorb the HAZMAT - chemically bond the material to something else
- Turn liquid HAZMAT into a semisolid gelatinous phase
- Neutralize the HAZMAT - apply acid or base to a spill to form a neutral salt
- Solidify the HAZMAT - using additives, change a hazardous liquid into a solid

(4) Communicate results of mitigation and assessment of damages to personnel and property to HAZMAT incident response team leader and OSC

g. Perform decontamination - remove contaminants by chemical or physical processes

(1) Set up DECON procedure

- Determine prescribed decontamination process (from BEE/ HAZMAT incident response team leader)

- Determine equipment necessary
- Lay out equipment in prescribed manner
- Mix and apply chemicals and reagents as directed

(2) Operate decontamination station as directed by team leader

- Perform dilution operations
- Perform absorption operations
- Perform chemical degradation operations

(3) Monitor exiting personnel and DECON personnel for signs and symptoms of exposure and heat exhaustion (FRA, f)

(4) Pack contaminated disposables as prescribed

(5) Perform prescribed decontamination of DECON personnel and reusable equipment on termination of incident

h. Perform Termination Activities

(1) Perform documentation tasks

- Write a report describing what the responder witnessed and did and what materials were used
- Turn in report to the HAZMAT incident response team leader

(2) Participate in debriefing activities, as directed

4. Hazardous Materials Technician (HMT) Level

The HMT is trained to safely handle the technical aspects of a HAZMAT incident up to but not including the cleanup. With one exception, they are generally team leaders, supervising directly the reconnaissance team, the entry team, and the decontamination team. The exception is the team information officer, whose task is to maintain communications with the FCC and to use the various available data bases and manuals to help identify HAZMATs and facilitate action planning. HMTs must be trained to perform the following tasks:

a. Initiate response

(1) Direct and perform detection and assessment activities

- Identify any criteria for modifying First Responder assessments
- Confirm, correct, or expand upon initial identification
- Detect presence of unseen/unknown HAZMATs using measurement devices
- Measure concentrations of known substances in the air, water, and on the ground using various measurement devices
- Collect samples of hazardous substances periodically during the incident for analysis purposes
- Assess the possible damages to people and property
- Gather and record field information regarding the incident
- Determine the nature of the HAZMAT incident
- Determine the location of the incident

gency

- Determine the date and time of the HAZMAT emergency
- Identify the contents of all exposed containers
- Determine the size of the spill or release
- Determine whether immediate evacuation is required and what type of evacuation is indicated

(2) Alert and activate the response team [FRA, I,(2)]

(3) Establish and maintain communications links with off-scene command.

- Keep off-scene command informed of findings, efforts, and events.

- Relay messages between onsite and off-scene commanders

- Relay requests for assistance and information between onsite and off-scene commanders

- Establish communications with arriving units holding in staging area

- Keep arriving units informed

- Summon units as needed

b. Initiate site management and control (FRA, b.)

(1) Evacuate, if necessary [FRA, b,(1)]

(2) Isolate the area [FRA, b,(2)]

(3) Control access [FRA, b,(3)]

c. Direct identification and classification of the HAZMAT

(1) Recheck/verify First Responder's identification

(2) Use various resources to assist in identifying HAZMATs and in planning response

- Use HAZMAT information sheets, MSDSs, or computerized equivalent to help determine type and location of hazard

- Use shipping documents to identify material

- Contact shipper and/or manufacturer for identification and information

- Use databases as needed for spill identification and action planning

- Use reference guidebooks in identifying hazards and planning response

(3) Implement safety precautions [FRO, c,(3)]

(4) Approach the scene [FRO, c, (4)]

(5) Size up the site [FRO, c,(5)]

(6) Use handbooks and databases to identify materials, properties, and hazards [FRO, c,(6)]

(7) Identify the chemical and physical properties of the HAZMAT [FRO, c,(7)]

(8) Identify the state the HAZMAT is in [FRO, c,(8)]

(9) Identify how the environment is affecting the HAZMAT [FRO, c, (9)]

(10) Identify what is causing the spill [FRO, c, (10)]

(11) Identify dispersion media, dispersion pattern, and the rate and quantity of the release [FRO, c, (11)]

(12) Extract and interpret information using various monitoring devices (e.g., oxygen meters, combustible gas indicator/explosimeter, carbon monoxide meter, pH meter, color/metric detector tubes, organic vapor analyzer, photoionization meter, air-sampling device, devices to measure chlorine, hydrogen sulfide, or ethylene oxide, pH paper or strips, organic vapor badge or film strip, mercury badge, dosimeter, Geiger-Muller counter)

(13) Use radio to pass information and seek advice from experts [FRO, c,(12)]

(14) Perform incident identification procedures

- Determine the nature of the HAZMAT incident

- Determine the location of the incident

- Determine the date and time of the HAZMAT emergency

- Determine the required level of HAZMAT incident

response

d. Assess risk (FRA, d.)

(1) Determine possible risks to people, property, and environment from HAZMAT identification [FRA, d,(1)]

(2) Determine exposure paths and vulnerabilities in exposure paths

(3) Estimate times until exposure of identified vulnerabilities

(4) Estimate nature of the container stress

(5) Estimate potential behavior of the container and its contents

(6) Estimate likely harm without intervention [FRA, d,(2)]

e. Communicate to agencies/persons with authority (FRO, e.)

f. Perform planning activities as directed by SFO:

(1) Prepare a contingency response plan (to minimize contamination or contact; utilize correct protective clothing; limit spread of contaminants; dispose of contaminated materials; provide adequate number of personnel to handle the incident; provide adequate resources and equipment to handle incident; decontaminate victims; facilitate termination; communicate plans to team leaders and members)

(2) Establish communications processes

- Establish methods and channels of communication

- Assign frequencies and establish rules of access to frequencies

- Establish lines of contact

- Coordinate communications with mutual aid response units

- Establish methods for disseminating key information among emergency response personnel located throughout the incident scene

(3) Plan team response strategy, based on the type team reconnaissance, entry, or decontamination)

(4) Communicate response strategy to safety officer and team members

g. Secure the scene (FRO, f.)

h. Direct and control response activities

(1) Establish a command structure

- Identify the OSC
- Establish a chain of command
- Assure coordination of incident response team
- Allocate responsibilities to on-scene personnel for various functions and tasks
- Notify incoming units of responsibilities for various functions and tasks

(2) Implement the response plan

i. Perform HAZMAT control/containment and stabilization

(1) Ensure proper gear is selected, inspected, and donned

(2) Supervise entry team

- Prepare for entry
- Assemble personnel in staging area
- Determine prescribed method for controlling the incident
- Determine which personnel are the most qualified to handle the incident
- Communicate plan to response personnel
- Select appropriate tools for containing/controlling the spill (plugging materials, dirt, shovels, tarps, etc.)
- Direct and perform physical mitigation procedures [FRO, g,(2)]
- Direct and perform chemical mitigation procedures [FRO, g,(3)]
- Communicate results of containment and assessment of damages to the safety officer

(3) Supervise backup team

- Keep backup team informed
- Maintain fresh backup personnel

(4) Communicate results of containment and assessment of damages to personnel and property to OSC

j. Direct and Control Decontamination Operations

(1) Establish decontamination site

- Determine whether DECON can be carried out safely
- Choose location for decontamination operations

(2) Set up for decontamination

- Identify which is the most acceptable method of decontamination (dilution, absorption, chemical degradation, or disposal and isolation)

- Determine the correct DECON protocol to be followed

- Determine whether the DECON site should be located on soil or hard surface

- Ensure site is properly marked and roped off

- Determine what are the hot, warm, and cold zone areas and make sure that they are properly identified

- Determine where the entry and exit check points are and make sure that they are properly identified

- Determine how much of the DECON must be done by the HAZMAT incident response team and how much can be done by a cleanup contractor or the agency responsible for the spill

- Determine what type of neutralizing agents are required and in what quantities

- Determine which DECON solutions are required

- Identify what are the symptoms for an acute exposure to the HAZMAT and pass this information on to all personnel

- Cover the DECON site with plastic

- Determine which DECON stations are required

straight line - Make sure that the DECON corridor is set up in a

3-feet apart and have DECON procedure signs which can be read by personnel in personal protective clothing

used for DECON - Determine what local permanent buildings can be

ments - Ensure sufficient supplies to meet DECON requirements

contamination - Determine whether plastic bags will contain the

rubber - Determine whether the contamination will affect

have been set up and that they are functioning properly

water source during the emergency - Make sure that water runoff will not affect any

riately dressed for the type of exposure and HAZMAT

required onsite for emergency treatment and, if it is, make sure that it is available

staff are set up (i.e., protection for them and their ambulance) to handle contaminated patients

entry, backup, and DECON personnel - Make sure that baseline physicals are available for

appropriate guidance on the HAZMATs are prepared and ready to go with the contaminated or suspected contaminated patients to the hospital

the symptoms and first aid procedures for heat rash, heat cramps, heat exhaustion, heat stroke, frostbite, and hypothermia

open wounds or have taken alcohol or medicine recently - Make sure that none of the DECON personnel have any

- Make sure that a transportation vehicle is available if the DECON area is more than 100 yards from the work area in the hot zone

- Make sure that plastic has been draped over the transportation vehicle and that respiratory protection is available for the driver

(3) Maintain safety during decontamination operations

- Ensure that DECON and entry personnel have been briefed on which protocol will be utilized

- Ensure that the DECON protocol is being properly followed

- Ensure that heart rate, blood pressure, and body temperature and weight are being taken on personnel who are wearing personal protective clothing

- Ensure that personnel are being observed for indicators of toxic exposure

- Ensure that fingers, toes, and ears are being checked on personnel coming through DECON during cold weather

- Ensure that personnel are monitored for heat stress when the temperature is above 80°F

- Ensure that monitoring for contaminants at the DECON site is performed

- Ensure that swipe tests are done on the skin of all personnel, and on all protective clothing and equipment

- Ensure that contaminated tools and equipment, and wooden and leather items are being kept in the hot zone during response operations

- During incidents which require chemical degradation, ensure that the mixing and application of chemicals is being performed correctly

- Ensure that none of the DECON personnel are eating, drinking, chewing gum, or smoking in the DECON area

- Ensure that the windows in the transportation vehicle are being kept closed when it is in the hot zone

- Ensure that all personnel take showers and that areas such as the head, groin, and ears are emphasized during body washing

- Ensure that all personnel departing DECON receive a medical evaluation

- Ensure that pieces of protective equipment are being wrapped separately to reduce the spread of contamination

- Ensure that overspray and splashing are minimized during DECON, and that water runoff is being diverted to a safe area

- During vehicle DECON, ensure that the wheel wells and chassis are cleaned thoroughly and air filters are changed onsite, and are disposed of properly

(4) Terminate HAZMAT DECON procedures

- Ensure the HAZMAT carried out of the hot zone by or on exiting personnel has been isolated, bagged, and placed inside plastic containers

- Ensure that all disposables have been properly placed inside overdrums

- Isolate containers from each other

- Clean all pieces of equipment owned by the AF

- If clothing is going out for laundering, ensure that bags are taped closed

- Ensure that all personnel equipment is sanitized and sent to maintenance for inspection

- Conduct permeation tests on personal protective clothing

- Decontaminate and tag fire hoses for pressure test

- Complete appropriate documentation

k. Perform termination activities

(1) Evaluate results of mitigation and decontamination activities

(2) Inform the OSC of findings, with recommendations regarding termination of incident

(3) Provide support services to cleanup crews, as needed

(4) Resume normal operations

- Remove barriers and allow normal traffic flow

- Provide public information

1. Perform Debriefing and Incident Followup Activities

(1) Perform documentation tasks

- Record HAZMAT information (name of material, hazards, containers, amount released)

- Document emergency response operations completed

- Record damage assessment

- Document costs of response and clean-up operations

- Submit documentation to appropriate local, state, and AF agencies

- Submit documentation to OSC

(2) Evaluate response effort

- Assess actual response actions

- Compare planned and actual response actions

- Identify areas for improvement

- Incorporate improvements into plans and procedures

- Develop and deliver training to personnel as required

(3) Restock supplies

(4) Return equipment to operational status

5. Hazardous Materials Specialist (HMS) Level

The HMS is the most highly trained member of the HAZMAT incident response team. His/her duties are primarily of a decision-making and supervisory nature, though they include the ability to function on the levels of HMT and First Responder. The specialist should be able to perform any of the positions in the HAZMAT incident environment. Positions normally filled by a specialist include SFU, HAZMAT Incident

Response Team Leader, and Safety Officer. Tasks of the HMS are listed at broad levels except where they depart from those of the HMT.

The SFO is the person in charge of a fire unit that responds to a fire call. In many cases this will be the fire chief or it may be an Assistant Fire Chief. In any event, this person will function as the OSC from when a HAZMAT is initially discovered until he determines that the situation warrants a broad response, requiring one or more outside people, including the Base Commander, CE, BEE, or civil response units.

In many cases, the SFO will determine that the incident can be handled by the fire unit and/or the unit responsible for the HAZMAT release. This occurs usually when there is a spill that does not present extraordinary difficulties such as high toxicity; threat of environmental harm; potential for damage to other property or injury to other people; or failure to confine the hazard to the base, base property and base personnel. In these cases, the SFO will act as OSC at least through the point at which the HAZMAT has been contained and stabilized. If the release is minor, he will then ensure that the unit responsible for the HAZMAT safely cleans it up. If the release is such that the responsible unit cannot handle the cleanup, then the SFO will call in the Base Commander, who will actively assume the role of OSC for the duration of cleanup. In either case, the SFO's responsibility becomes one of providing fire and safety support to the cleanup effort.

In this capacity of OSC, the SFO may either elect to handle the HAZMAT portion of the incident himself or to call in the HAZMAT response team leader. If the team leader is called in, the SFO responsibilities are split; the SFO continues to direct the firefighting efforts but with the team leader now assuming the HAZMAT tasks under the SFO's direction. In effect, before calling in the team leader, the SFO has been performing as both the SFO and HAZMAT incident response team leader.

If the incident is a major one, the SFO will call in the Base Commander, who as the OSC will activate additional units as needed. The Base Commander will also activate the response plan, including contacting civil agencies, etc. Normally, the SFO will not have to contend with such matters as activating response plans and mobilizing outside agencies. For this reason, the task listing given here does not include tasks of this type.

The team safety officer is more directly connected to the incident, directly supervising all of the activities of the entry teams. There are occasions, however, when one person might function in all three specialist roles.

The HMS must be trained to perform the tasks listed below. This listing does not explicate all of the tasks which the specialist oversees at the lower levels of the hierarchy. Instead, tasks unique to the specialist are listed, along with filler tasks that he supervises and which are listed for continuity in the listing.

a. Respond to the HAZMAT Incident

- (1) Define the site and exclude people
- (2) Identify the materials involved
- (3) Evaluate the magnitude of hazard and risk to AF and civilian personnel and property
 - Determine whether the quantity of the HAZMAT spilled meets or exceeds the statutory reportable quantity for that material
 - Determine the required level of HAZMAT incident response
 - Determine the need for notification of the Base Commander/activation of the response plan
 - Determine the number of fire department personnel needed to respond to the incident
 - Direct the fire communications center operator to notify other agencies as required

b. Function as the OSC until the arrival of the Base Commander or his designated representative

- (1) Establish control of the site
 - Define the site and exclude people
 - Establish zones
 - Communicate zones to all personnel
 - Authorize the distribution of HAZMAT equipment from the HAZMAT incident response vehicle
 - Remove medical casualties
 - Fight fires
 - Prevent explosions
 - Shut down utilities as required
- (2) Identify the materials involved
 - For unknown/unconfirmed HAZMAT releases, direct reconnaissance and identification

- Identify occupancy and contents when incident is in an interior exposure

(3) - Assess hazard and risk

- Assess the characteristics of the release
- Estimate the time until exposure of identified vulnerabilities

- Determine the risk and hazard to personnel and property

- Reevaluate the hot zone to make sure it is adequate

- Estimate harm without intervention

(4) Coordinate information and resources

- Assume command over all units on the scene

- Assemble response personnel in a staging area

- Establish a command structure

- Establish a chain of command

- Allocate responsibilities to on-scene personnel for various functions and tasks

- Notify incoming units of their responsibilities and tasks

- Determine and elaborate plan of action

- Determine containment priorities (e.g., prevent further spread, neutralize, or repackage?)

- Contact facility, carrier, manufacturer, supervisors, or HAZMAT advisors and discuss proposed plan of action, time permitting

- Organize response team

- Assign personnel to positions called for in response plan

- Communicate response plan to personnel assigned roles

- Manage on-site communications

- communications
 - Establish onsite methods and channels of
- Establish backup communications methods (such as
- hand signals or lights
 - Establish methods for disseminating key information among emergency response personnel at the incident scene
- Establish structure for safety
- safety officer
 - Assign responsibility for safety to the team
- Communicate the hazard zones, communication and warning systems, and safety regulations in effect
- Brief personnel on exposure signs and symptoms
- warm zones
 - Designate entry team and backup team for hot and
- Confirm that the team safety officer's safety plan meets requirements of situation
- Confirm that selected required protective clothing meets requirements of the situation
- Enforce safety regulations
- Supervise entry and exit to/from hazard zones
- Ensure that the medical unit monitors personnel before donning of protective clothing (baseline physiological indices) and when exiting hazard zones changes from baseline plus readings of exposure
- Enforce rules on times of exposure
- Enforce rules on time of SCBA use
- Enforce exclusion of all but entry and backup personnel from warm and hot zones
- Shield equipment and apparatus from exposure
- Ensure general welfare of personnel
- Provide food, drink, and warning against ingesting contaminants

in

- Provide toilet facilities
- Provide rest areas
- Rotate fatigued personnel out, fresh personnel

- Provide emergency medical care and rescue
- Oversee/supervise team components (safety officer, information officer, reconnaissance team, decontamination team, entry and backup teams)

(5) Direct material control/containment

- Contain materials to present location
- Prevent further leakage from the container
- Evaluate efforts
- Evaluate incident for termination

(6) Direct and control decontamination operations

- Establish decontamination area
- Establish decontamination process
- Check personnel and equipment for contamination
- Provide emergency medical care for exposed/injured personnel
- Decontaminate all exposed personnel and equipment onsite
- Provide medical monitoring of exposed personnel following decontamination
- Prepare for off-site decontamination of persons and equipment if needed

(7) Direct termination activities

- Determine that the HAZMAT no longer poses a threat to life, property, or mission.
- Recheck decontamination
- File reports

- Evaluate effectiveness of response activities in consultation with offscene commander

- Formulate changes in operating procedures, areas requiring further training, and other changes arising from incident evaluation

- Debrief all involved response personnel on response effectiveness, mistakes made, lessons learned, and changes in operating procedures

- Perform medical followup

Monitor all entry personnel and other personnel who may have been exposed immediately after decontamination

Monitor all entry and exposed personnel periodically over the period of expected onset of symptoms or effects

c. Turn over operations to the Base Commander

- (1) Provide technical assistance, as needed.

- (2) Provide support services during postincident cleanup

- (3) Perform debriefing, critiquing, and other postoperations activities

- (4) Ensure that emergency equipment is restored to full operational status

d. Perform team safety officer tasks

- (1) Maintain incident site log

- (2) Formulate and implement safety plan

- Provide the OSC with recommendations on the establishment of control zones

- Evaluate the positioning of the incident response team's personnel and equipment

- Determine a safe command post location

- Determine a safe staging area

- Decide entry/no entry

- Select appropriate protective clothing

- Install proper decontamination process before entry
- Select appropriate response (chemical and physical containment operations)
- Maintain communication between entry personnel, self, and OSC
- Maintain control and security of entry and exit of all personnel between the zones
- Determine when personnel should be withdrawn from the hot and warm zones
- Inspect protective gear before entry and after decontamination
- Ensure that the entry team checklist is being followed and completed
- Ensure that the hazard and procedures briefing is completed by the HAZMAT incident response team leader
- Ensure that the signs and symptoms of chemical exposure and heat stress are communicated to all involved personnel
- Ensure that the emergency warning signals are known by all HAZMAT incident response team personnel
- Ensure that the entry operations are being coordinated with the decontamination personnel
- Ensure that emergency medical services and transport are in place at all times during entry
- Monitor the entry personnel for signs/symptoms of chemical exposure and heat stress
- Restrict entry into the hot zone to HAZMAT trained personnel and individuals possessing particular knowledge of the problem/situation
- Remain in constant contact with the team leader and entry personnel
- Ensure that the entry and backup teams are properly clothed before entry
- Maintain a backup team in full protective clothing appropriate to the response at all times during entry team operations

- Ensure that all incident information is gathered and recorded; pertinent documents, manifests, and reports are collected and safeguarded

C. HAZMAT TRAINING COURSES AND THEIR SOURCES

HAZMAT training is available in several forms, consisting mainly of courses, videotapes, and books. Books are not listed or evaluated in this report; however, an extensive listing is available in Fire Service Directory of Training and Information Sources (Reference 40). The abstracts of courses (Appendix M) provide enough information about the content of the course and its contact. Where possible, each course is also identified for its appropriate HAZMAT training level (FRA, FRO, MT, and HMC). These courses can be used for continuing education purposes and primarily are offered as federal training courses; DOD/Military courses; state and quasi-state government courses; city and county government, non-fire department; fire departments; college, university, and fire school; associations and institutes, non-government; and private industry. Addresses of these sources for these entries are given in Appendix N.

A very thorough listing of federal HAZMAT training sources is provided in Federal Emergency management Agency's Digest of Federal Training in Hazardous Materials (Reference 41). Most of these programs are also listed in Appendix N with an indication of the level for which the course is recommended. Agencies offering HAZMAT training include:

Federal Emergency Management Agency (FEMA), National Emergency Training Center: NFA, and Emergency Management Institute (EMI), Emmitsburg, Md.

NFA is one of the best-respected training agencies for firefighter training in the nation. Courses are offered at all levels, and many of its courses are accredited for college credit, transferable to many degree programs. In addition to its fire protection courses, NFA teaches firefighter HAZMAT courses. EMI is located next to NFA at Emmitsburg, Md., and offers similar coursework. EMI offers courses more on the HMS level than the lower levels, while NFA offers courses for the lower and middle levels. In addition, EMI offers a home-study program, although its applicability to AF needs is questionable. Abstracts of FEMA courses are in the Digest, but courses for which more detail is needed are also listed in Appendix N.

FEMA also offers training programs out of its regional offices. The offices are located in: Boston, Mass.; New York, N.Y.; Philadelphia, Penn.; Atlanta, Ga.; Chicago, Ill.; Denton, Tex.; Kansas City, Mo.; Denver, Colo.; Presidio of San Francisco, Calif.; and Bothell, Wash.

Department of Energy

DOE offers a series of courses on radiological emergency management.

Department of Labor, OSHA, Occupational Health Training Branch, OSHA Training Institute, Des Plaines, Ill.

OSHA offers two HAZMAT-related courses. These are not primarily for firefighters and are not recommended except as a source of material for AF training.

DOT, Transportation Safety Institute, Oklahoma City, Okla.

Two HAZMAT courses are offered by DOT; these are recommended as continuing training or as a source of material for the FRO courses. A field exercise is offered by DOT/U.S. Coast Guard to test local response coordination. DOT/Transportation Safety Institute offers a course on cargo tank compliance and enforcement which might be useful in constructing coursework for FROs.

Nuclear Regulatory Commission, Regional Office

NRC offers one course on radiation protection and dose assessment. This course is primarily reactor-oriented and not recommended to AF.

Tennessee Valley Authority, Fire Training Center, Jasper, Tenn.

TVA offers one course at present, and is developing others. This course is listed in Appendix N only, and is not in the Digest.

New responders at NOAA/U.S. Department of Commerce, HAZMAT Response Branch, Seattle, Wash. are required to take a 200-hour course, an in-house training program using EPA Incident Response Operations course and other material. The course is restricted to in-house field personnel, and is not well outlined.

EPA courses cover a wide range of topics of importance in HAZMAT training; they are recommended either as continuing training courses or as source material for AF courses.

Very little HAZMAT training is offered by the military sector, despite a concentration of HAZMATs on military installations. AF training is as good as or better than that offered by any other branch but still needs to offer much more. It is not recommended that AF draw heavily on non-AF military training in developing courses, with the possible exception of Coast Guard courses.

The AF offers training at Chanute Air Force Base, Ill., as well as courses and training units originated locally at several bases.

The Army Logistics Management Center offers a 4-day course at Fort Lee, Va. The Navy offers very little HAZMAT training, and the Coast

Guard offers more HAZMAT training than any other military service. A Department of Defense, DARCOM Ammunition Center, Ammunition School, Savannah, Ill., offers a course which covers a number of HAZMAT topics. Joint Military Packaging Training Center, Aberdeen Proving Ground, Md., also delivers some HAZMAT training. Courses are presented on packaging HAZMATs, as well as one 4-hour course on handling HAZMATs.

Private industry training is available at a variety of prices, in a variety of qualities, and with high prices not necessarily meaning high quality. An important feature to consider is whether a company is willing to tailor training to AF needs. Before any private industry source is used, AF should evaluate all of the public sources, especially NFA and NFPA, and then request proposals from a number of private sources not to deliver specific training but to develop that training and teach AF personnel to deliver it.

For detailed listing and additional information on training courses, Appendix N must be consulted.

D. CRITERIA FOR CERTIFICATION OF RESPONSE PERSONNEL

1. Overview of the Certification Process

The basic requirements for certification at various levels of HAZMAT response are set forth in this section. These requirements are of two parts for each level. First, trainees must have completed a course curriculum providing knowledge and skills set forth below. When the coursework is completed for a response level, a certification will be issued that permits the trainee to begin practical training at that level of response at his duty station. As in Section IVA, decontamination is addressed as if it has been assigned to the fire department.

For full certification at a response level, the trainee must meet a set of locally determined requirements that are listed on a practical factors-type checklist. The content of this checklist includes such things as familiarity with the local response plan, familiarity with mutual aid agreements, what materials are commonly found at or near the trainee's duty station, what equipment is available locally (and how it is operated), and other information and procedures specific to the duty station. Certification for these factors may come from a written test on some factors, such as response plan, and from actual physical operation of equipment and/or performing tasks for other factors. A firefighter is not likely to have the opportunity to perform all of the tasks required for certification under actual emergency conditions; therefore, the local command will be tasked with providing simulation opportunities during training and periodic drills (which are required by EPA on a regular basis). Final response level certification will consist of completing the coursework for that level and completing the practical factors for that level at a duty station. The final certifying authority will be the local head of the HAZMAT unit, often designated RTL or Response Team Officer.

If a person who is certified at a certain level transfers to a new duty station, he will retain formal certification but will be required to be closely supervised until checked off on the practical factors for the new duty station. When the certified person reports to a new duty station, he will immediately complete a study plan with the head of the HAZMAT unit. The plan will provide for completing the practical factors at all of the lower levels, as well as at the present level. This method of recertification should not require demonstration of all of the tasks on those practical factors. For instance, there may be equipment at the new duty station that was also at the old one and was already checked off. The HAZMAT unit commander may check off this requirement for the new duty station, if the interview convinces him that the firefighter is adequately trained on this requirement.

Other practical requirements are not expected to differ between duty stations. For example, an HMT might be required to demonstrate the tasks of Decontamination Team Officer (if this becomes the responsibility of the fire department) at the previous duty station before certification. The HAZMAT unit commander at the new station should be able to determine through interview and previous performance evaluations how well the firefighter has mastered this set of skills and, at his discretion, provisionally check off this requirement. Even so, the new person should be closely supervised in performing that duty until his competency has been soundly demonstrated in drills or in a response action.

Normally, a trainee will have completed the coursework before beginning to operate at a response level. All HAZMAT firefighters will complete the FRA training before starting any HAZMAT firefighting operations. Ideally, the coursework for this level should be given in the NFA. Once the firefighter has completed the training for the level and has begun to meet local requirements, he should begin to receive coursework for the next response level. This will provide trained personnel at higher levels of response capability, while meeting federal "continuing training" requirements.

The issues of certification and recertification as well as continuing training have been addressed, but these alone are not sufficient to ensure that personnel operating in the HAZMAT environment will continue to be fully prepared and competent. The issue of continuing certification is also important because several "sources of skill obsolescence" could cause a firefighter to be unable to function adequately and safely in a HAZMAT situation. These include age, physical condition (e.g., illness), obsolete technical knowledge, and lack of practice. Therefore, a person should have to demonstrate continuing competency through adequate performance evaluations to maintain certification at a given level, unless that person has been assigned duties outside the HAZMAT realm, such as an administrative position or a non-HAZMAT firefighting role. If a firefighter is out of the HAZMAT response lineup for more than 6 months, his certification should become provisional. Temporary restrictions of certification should also be considered appropriate in the HAZMAT environment. For example, a person may be on certain medication which may impair functioning or may render

the user more susceptible to suffering the effects of slight exposure. Similarly, if an individual is severely ill or under heavy stress (for whatever reason) he may be more susceptible to the effects of limited exposure. Finally, a person who is exhibiting unusual behaviors, such as frequent arrests or depression, should have his certification restricted pending professional assessment of his mental and/or behavioral stability.

The implication of this certification and recertification for the HAZMAT unit commander is that he has a huge responsibility. Certifying an individual entails trusting him to take action under loose supervision that will expose human life to certain risk. Although that authority can be delegated through certification, the responsibility for those lives cannot be delegated.

2. Criteria for First Responder Awareness Level

To be eligible for basic certification, the trainee must have completed basic firefighting training as well as a basic curriculum of HAZMAT subjects. Initially, basic certification requires demonstrating the competencies listed below while in a training environment. Proficiency is anticipated to take approximately 40 hours.

Operational certification as FRA requires completion of a set of practical factors based on duty station conditions and requirements as well as at least 6 months of response on a unit that might have to respond to a HAZMAT incident. Some potential local certification requirements are listed below with similar requirements for the other levels.

a. Preliminary knowledge--what HAZMATs are and what risks are associated with them

(1) Give a basic definition of a HAZMAT and a HAZMAT incident/emergency

(2) Recall the HAZMATs most likely to be found on a base and where they are likely to be located

(3) Describe the roles on a response team and what duties are beyond FRA expertise

(4) Describe the ways HAZMATs are different from other emergencies

(5) Describe the ways HAZMATs are dangerous to people and how HAZMATs enter and affect the human body

(6) Describe the threats to the environment posed by HAZMATs

(7) Describe the potential dangerous outcomes associated with a HAZMAT emergency

(8) Describe the NFPA General HAZMAT Behavior Model and Events Interruption Principles

b. Initiate response

(1) Detection and assessment

- Demonstrate how to safely approach an unidentified or identified HAZMAT or HAZMAT site or simulated site

- Describe how to detect and identify HAZMATs on the basis of occupancy/location, container shapes, markings and colors, placards and labels, shipping papers, and senses; identify where these specific indicators can be located

- Demonstrate ability to identify various HAZMAT containers

- Describe the DOT and NFPA identification and numbering systems for HAZMATs

- List the nine United Nations and DOT HAZMAT classes, the hazards associated with each, and give examples

- Describe the types of specialized marking systems found at fixed facilities on bases

- Discuss the content and uses of MSDS

- Explain the problems in specifically identifying HAZMATs

- Demonstrate the use of the DOT Emergency Response Handbook (Reference 2)

- Demonstrate use of people onsite to identify the HAZMAT

- Demonstrate use of CHEMTREC to identify the HAZMAT

- Discuss use of binoculars for identifying the HAZMAT

- Demonstrate gathering and recording field information regarding an incident or simulated incident

- Describe hazards to people and property of various examples from each class of HAZMAT

required

- List the criteria for when immediate evacuation is

- Discuss safety procedures for contaminated personnel

- Discuss what information to pass to response team on personnel who have been contaminated and/or injured

- Demonstrate ability to pass on appropriate information to SFO

(2) Alert and activate the response team

- Describe a typical response plan, the components of a response team, and their roles/duties are

- List criteria for when a HAZMAT is beyond the awareness level expertise

- Describe who are the appropriate people to call for additional assistance

- Demonstrate how to combine preliminary assessments of the incident into a coherent verbal report for response team

- Describe the correct procedures for requesting additional resources for dealing with specific HAZMAT incidents

- Describe the communication procedures prescribed for first responders

- Discuss who to notify of an incident (e.g., AF officials and responsible party, etc.)

c. Initiate site action and control

(1) Demonstrate basic techniques of protecting oneself at a HAZMAT incident

(2) Describe recommended methods of protecting civilians, response personnel, and the environment during a spill incident

(3) Identify situations too dangerous for various types of protective clothing

(4) Describe evacuation procedures for HAZMAT incidents

(5) Describe rescue procedures for injured personnel

(6) Discuss the importance of controlling access to the incident site

- (7) Demonstrate procedures for isolating a HAZMAT site
 - Determine isolation distances for various HAZMATs
 - Set up barriers around a site
 - Isolate floors or areas of a building
- (8) List criteria for a safe staging area
- (9) Discuss use of staging area to control site access to authorized personnel

d. Initial identification

- (1) Discuss which information to use to help identify a HAZMAT
- (2) Describe three types of HAZMAT (chemical, biological, radioactive)
- (3) Describe the chemical and physical properties associated with various examples of each class of HAZMAT
- (4) Describe the various physical states a HAZMAT can be in (gas, solid, liquid, high or low pressure)
- (5) Describe how the environment can affect the HAZMAT (terrain, wind, heat, cold, etc.)
- (6) Describe how HAZMAT incidents can occur (leaks, vaporizing gas, etc.)
- (7) Using various reference materials, demonstrate ability to determine flashpoint, ignition temperature, water solubility, flammability, specific gravity/density, vapor density, and boiling/vaporization point

e. Assess the potential risks of the hazard

- (1) Describe the hazards to people and property for particular HAZMATs
 - Describe the hazards to health and safety created by each class of HAZMAT
 - Given sample incidents, describe what hazards to life exist.
 - Predict the outcome if no intervention is made for various HAZMATs

f. Communication

(1) Discuss the importance of communication throughout the incident response process

(2) Discuss the procedures of communications prescribed for HAZMAT incidents

g. Perform basic containment and control operations (Level I responses)

(1) Demonstrate the ability to don, use, and doff basic protective clothing

(2) Demonstrate the ability to perform basic physical mitigation procedures

(3) Demonstrate the ability to perform basic chemical mitigation measures

(4) Demonstrate the ability to perform basic decontamination procedures

3. Criteria for First Responder Operational Level

To be eligible for basic certification, the trainee must possess all the knowledge, skills, and abilities of the FRA on a more hands-on level. In addition to the above outlined dimensions, the FRO level entails additional knowledge and abilities within those dimensions, and additional knowledge dimensions not part of the FRA certification. As an example of these differences, the FRA is not anticipated to use advanced protective clothing, or to perform advanced mitigation procedures, but the FRO will. The additional material is listed below. Initial certification is predicated on demonstrating these knowledge and ability factors. The trainee must have successfully completed training for FRA and meet the proficiency of the following prescribed competencies through accredited schools or courses. The trainee must have performed in a response role as FRA for at least a year following final FRA certification. Proficiency is anticipated to take approximately 160-200 hours of classwork and field exercises beyond FRA proficiency.

To be eligible for operational certification at this level, the trainee must have satisfactorily met local knowledge and ability requirements and should have performed for a period of 6 months post-course work on a unit that is involved in HAZMAT response.

a. Initiate response

(1) Identify the dangers of search and rescue missions specific to HAZMAT incidents

(2) Demonstrate how to determine evacuation distances and their limitations; describe evacuation based on dispersion pattern and wind direction

b. Initiate site action and control

(1) Demonstrate ability to establish control zones (hot, warm, and cold zones)

(2) Demonstrate ability to assess adequacy of control zones in use

(3) Demonstrate ability to assess resource needs and equipment adequacy

c. Personal Protective Clothing

(1) Demonstrate a working understanding of the four levels of protection, the criteria for using each, and the clothing used for each

(2) Demonstrate how to inspect, don, and check protective clothing

(3) Know signs of breakdown/degradation of protection provided by protective clothing

(4) Demonstrate use of appropriate protective clothing for various levels of response and for various HAZMATs

(5) Identify the respiratory hazards encountered at HAZMAT incidents and the need for proper protective breathing apparatus

(6) Identify the physical requirements of the wearer of protective breathing apparatus

(7) Describe the limitations of protective clothing and breathing apparatus at HAZMAT incidents

(8) Demonstrate the use of positive pressure air-supplied respiratory devices as provided by the authority having jurisdiction

(9) Describe the application, use, and limitations of the following types of protective clothing used at HAZMAT incidents

- structural clothing
- chemical protective suits, encapsulating and nonencapsulating
- high-temperature clothing

(10) Demonstrate ability to assess the adequacy of various types of protective clothing for various HAZMATs

d. Initial identification of the HAZMAT

(1) Demonstrate understanding of basic chemistry and biological terms and how they apply to HAZMATs for each class of HAZMAT; discuss

- chemical and physical properties which render it hazardous

- chemical properties which can be used to neutralize the substance

- chemical reactivity and compatibility of various types of personal protective clothing and incident management equipment

(2) Demonstrate the ability to identify HAZMATs

- Given various examples of containers and packages, name an example of the material that may typically be found inside

- Locate vital information about the size and identity of HAZMATs from shipping papers (hazard class, quantity, placard notation, etc.)

- Identify technical references used for assistance in identifying HAZMATs

- Explain the following with regard to using CHEMTREC as an identification source:

- how they are accessed

- what assistance they can provide

- what information you must supply them

- Demonstrate ability to use HMIMS (or other computerized incident management data base)

- Discuss how specific HAZMATs might behave or travel, and identify factors that might affect the behavior of the HAZMAT

(3) Demonstrate ability to implement safety precautions in site reconnaissance

- Demonstrate knowledge of signs and symptoms of exposure to HAZMATs and display ability to monitor for them

- Demonstrate knowledge of allowed times in hot zone for various HAZMATs and ability to comply with permitted stay times

- Demonstrate knowledge of communications procedures in entry situations

- Demonstrate ability to monitor risk, hazard, and response situation

(4) Size up the HAZMAT incident site

- Determine wind direction and speed, terrain features important to incident management, obstacles and barriers, and site hazards such as down power lines, fire, threatened containers, etc.

- Identify how the environment is affecting the HAZMAT

- Identify dispersion media, dispersion pattern, and rate and quantity of release

- Use a radio to pass information and seek advice from experts

e. Implement the response plan

(1) Describe the elements of a response plan, how they coincide, and their importance in controlling an incident

- Describe who should be involved in the response to the HAZMAT based on specific information about the HAZMAT

- Explain FRO responsibilities when responding to a HAZMAT incident

(2) Describe the importance of preemergency planning for specific sites and HAZMATs

f. Incident management

(1) Demonstrate the ability to direct and control response activities by establishing a command structure and a command post

- Describe how the elements of the Incident Command System interact

- Describe the functions and responsibilities of the various functional groups in the incident command structure, including OSC, Safety Officer, Fire Communications Center Officer, RECON team, Entry team, and DECON team

incident

- Discuss the importance of coordination at a HAZMAT

- List the criteria for location of a command post

(2) Given radio frequencies, demonstrate how to set them up with the response team, and describe key personnel to which information should be disseminated

(3) Describe the content of typical HAZMAT standard operating procedures

g. HAZMAT control, containment, and confinement

(1) Discuss how to organize or coordinate personnel in preparation for responding to the HAZMAT

(2) Describe which mitigation approach is best for various HAZMAT incidents and what equipment and supplies are needed

(3) Describe how to perform both physical and chemical mitigation and demonstrate the following:

- Physical: Absorption, Dilution, Diking/Damming, Diversion, Dispersion, Overpacking, Plugging and Patching, Vapor Suppression, Transfer, Venting

- Chemical: Adsorption, Controlled burning, Dispersion, Flaring, Gelation, Neutralization, Solidification, Venting, and Burning

(4) Describe advantages and limitations of each of the above and when to use combinations of methods

(5) Demonstrate ability to assess mitigation/containment efforts and damages to personnel and property and to communicate results

(6) Demonstrate familiarity with common HAZMAT settings

- Demonstrate familiarity with aircraft incidents

- Demonstrate familiarity with HAZMATs, HAZMAT locations, and hazardous conditions commonly found on aircraft

- Demonstrate familiarity with typical aircraft methods of entry and egress and with typical aircraft fasteners

- Demonstrate ability to locate information concerning contents of an aircraft

- Demonstrate familiarity with rail car incidents

- Knowledge of typical rail car construction, various types of cars
- Familiarity with HAZMATs commonly found on rail cars on AF bases
- Ability to locate information on contents of rail cars
- Knowledge of procedures for shutting down traffic on the rail line)
- Demonstrate familiarity with highway incidents
- Knowledge of various vehicles which commonly carry HAZMATs on base
- Knowledge of the HAZMATs commonly carried on roadways on base
- Knowledge of how to locate information on HAZMATs carried on roadways
- Demonstrate familiarity with fixed facility incidents by describing
 - How topography, drainage, and utilities will influence response actions
 - Different types of fixed facilities and what HAZMATs they are likely to contain (eg., fuel farm, ordinance depot, aircraft maintenance facility)
 - Safety features and control systems built into these facilities
 - Where to locate information about the HAZMATs found in fixed facilities
- Demonstrate familiarity with pipeline incidents and describe
 - HAZMATs commonly carried in pipelines on AF bases
 - How pipeline pressure, size of leak, slope, pump station, and type of pump affect incident response
 - Procedures for responding to pipeline emergencies, including how to shut down the flow

- Where to locate information about HAZMATs carried in pipelines

h. Decontamination (if assigned to fire department)

(1) Demonstrate knowledge required for decontamination activities

- Describe how personnel, apparatus, tools, and equipment may become contaminated in a HAZMAT incident and the importance of decontamination procedures

- Describe what might happen if appropriate decontamination procedures are not followed

- Describe how to decontaminate victims and/or equipment using the basic principles of dilution, absorption, and chemical degradation

- Give examples of solutions used in dilution, absorption, and chemical degradation

- List the guidelines for safety in decontamination

(2) Demonstrate ability to set up the DECON procedure and

- To determine equipment necessary for various HAZMATs

- To lay out the necessary equipment in the proper location and sequence

- To mix various chemicals and reagents used for DECON

(3) Demonstrate the ability to operate the DECON stations (steps in the DECON process) and

- To perform dilution, absorption, and chemical degradation procedures

- To monitor exiting personnel for signs and symptoms of exposure and heat exhaustion

- To package contaminated materials as prescribed

- To decontaminate DECON personnel and equipment and to inspect and package equipment for reuse

i. Termination and debriefing

(1) Demonstrate ability to recall and document what the responder did and what materials were used

(2) Demonstrate ability to participate in a debriefing session

4. Criteria for Hazardous Materials Technician Level

To be eligible for basic certification, the trainee must possess all the knowledge, skills, and abilities of the FRO but on a more technical level. The HMT must be able to perform all the tasks of the FRO. In addition, he must assume leadership roles. This entails responsibility for the safety of others; therefore, the technician must possess the knowledge, skills, and abilities at a more complex level than that of the FRO. To be certified, the trainee must have successfully completed the requirements for FRO, satisfactorily performed as a FRO for at least 2 years on a unit that is involved in HAZMAT response, and demonstrated the prescribed competencies in the following subject areas through accredited schools or courses. Proficiency is anticipated to take approximately 122 hours.

To be eligible for operational certification at this level, the trainee must have met local knowledge and ability requirements and should have performed at the HMT level for a period of at least 1 year post-course work on a unit that is involved in HAZMAT response.

a. The HMT must possess an advanced knowledge of the chemistry and toxicology of HAZMATs

(1) Demonstrate workable knowledge of the periodic table of elements

(2) Demonstrate a knowledge of the principles of basic chemistry, inorganic and organic, and how they relate to HAZMAT

(3) Define the following terms, give similarities and differences where they exist, give health hazards where they exist, and give examples of how the terms are used in specific HAZMAT incidents:

- | | |
|-------------------------------------|------------------|
| - Corrosivity | - Hydrocarbons |
| - pH | - Aldehydes |
| - Strength | - Vapor Density |
| - Concentration | - Bases |
| - Polymerization | - Oxidation |
| - Catalysts and Inhibitors | - Vapor Pressure |
| - Sublimation | - Metals |
| - Volatility | - Non-salts |
| - Viscosity | - REM/RAD |
| - Surface Tension | - BLEVE |
| - Critical Temperature and Pressure | - Solutions |
| - Radioactivity | - Neutral State |
| - Oxidation Ability | - Valence States |
| - Instability | - Amines |
| - Air Reactivity | - Hydroxides |
| - Water Reactivity | - Ketones |

- | | |
|--|---------------|
| - Hydrides | - Compounds |
| - Units of measurement | - Explosives |
| - Acids | - Inorganics |
| - Ignition temperature | - Immiscibles |
| - Non-metals | - Exothermics |
| - Peroxides | - Alcohols |
| - Cryogenics | - Esthers |
| - Parts per million/billion
(ppm/ppb) | - Isotopes |

(4) Define concepts of acids and bases

(5) Give three examples each of protonic acids, polyprotic acids, hydroxide bases, electrolytic salt solutions, and hydrogen salts

(6) Describe the difference of the action of water on metal oxides from that of water on nonmetallic oxides.

(7) Describe the reaction and consequences of applying water to inorganic chemicals.

(8) Define the theory of acid-base neutralization.

(9) Describe the different types of oxidation

(10) Demonstrate a knowledge of 25 DOT hazard categories

- Define the hazard categories and give examples of each

- List the hazards posed by each hazard category, including but not limited to toxicity, flammability, reactivity, radioactivity, and corrosivity

- Describe the precautions applicable for each hazard category

- Describe hazards and characteristics of the decomposition of organic compounds due to fire

- Describe mitigation actions best suited to each hazard category

(11) Demonstrate a knowledge of the toxicology of the 25 hazard categories

- Define and compare each of the following toxicity rating methods and describe how each can be used to estimate the degree of toxicity:

- Toxic dose

- Lethal dose (LD₅₀)
- Lethal concentration (LC₅₀)
- Immediately dangerous to life and health
- Threshold limit value
- Short-term exposure limits
- Permissible exposure limit
- Discuss routes of entry
- Discuss the systemic effects of each and the degree of hazard
- Discuss target organ toxicity
- Discuss toxicity influencing factors of age and sex
- Discuss the signs and symptoms of exposure, both immediate and delayed
- Discuss precautions to be taken for each category
- Discuss the recommended action upon discovering signs and symptoms

(12) Describe the decision-making process for identification of unknown chemical, biological, or radiological hazards.

b. Reevaluate initial identification of the HAZMAT

(1) Demonstrate the ability to supervise the reconnaissance team in performing HAZMAT identification

(2) Demonstrate ability to confirm or verify the identity, state, and properties of the HAZMAT, using various information sources

- Describe the advantages and disadvantages of MSDS, reference guidebooks, HAZMAT data bases, and technical information centers (e.g., CHEMTREC)

- Describe the basic design and construction features of containers, bulk and nonbulk packaging, used to store, process, or transport HAZMATs, including:

drums	tank cars
cylinders	tank trucks and trailers
carboys	fixed tanks
boxes and bags	portable tanks/intermodal containers
cans and bottles	piping

(3) Demonstrate ability to use monitoring and sampling equipment to identify known and unknown HAZMATs

- Demonstrate the use of monitoring and sampling equipment used by the AF (may include oxygen meters, combustible gas indicator/explosimeter, carbon monoxide meter, pH meter, color/metric detector tubes, organic vapor analyzer, photoionization meter, air sampling devices, devices to measure chlorine, hydrogen sulfide, or ethylene oxide, pH paper or strips, organic vapor badge or film strip, mercury badge

- Discuss interpretation of results of use

- Discuss the limitations of these instruments

- Discuss the maintenance and testing of these instruments

(4) Describe the hazards of toxicity, flammability, reactivity, and radioactivity

(5) Demonstrate the ability to identify and explain the risk assessment considerations to be made at a HAZMAT incident, including size and type of container, nature of container stress, potential behavior of the container and its contents, levels of resources available, exposure potential to people, property, environment and systems, and weather conditions and terrain

c. Site management and site control

(1) Demonstrate ability to assess first responder's initial site management and control procedures and take corrective actions

- Demonstrate the ability to assess the adequacy of the established HAZMAT control zones

- Describe how to carry out proper procedures for staging and setting up all necessary zones

- Demonstrate the ability to reevaluate the evacuation parameters established by the first responder

- Describe considerations to be considered before ordering an evacuation

and safely

- Describe how to carry out evacuations completely

safety plan

- Demonstrate the ability to formulate and implement a

(2) Demonstrate the ability to establish and maintain communications links with off-scene command

- Demonstrate ability to keep off-scene command informed of findings, efforts, and events

- Demonstrate ability to relay messages between on-scene and off-site commanders

- Demonstrate ability to establish communications with arriving units holding in the staging area, to relay pertinent information to them, and to summon them as needed

d. Response planning and incident management

(1) Demonstrate the ability to perform incident identification procedures

- Determine the nature, location, date, and time of the incident

- Determine the required level of response

(2) Describe how the HMT expands the response plan by providing additional technical knowledge to limit the spread of the HAZMAT, completing both the decontamination process, and the termination process

(3) Demonstrate the ability to take control of the command structure (enforce control zones, disseminate information, and assess resource needs)

(4) Identify government and private agencies which offer aid during a HAZMAT incident, including their likely roles and the types of aid they provide

e. Personal protective clothing

(1) List criteria for when a HAZMAT incident requires structural or chemical protection

(2) Demonstrate knowledge of the performance requirements, chemical resistance, permeation, penetration, flexibility, chemical incompatibility, abrasion, sealing deficiencies, disintegration, temperature resistance, and shelf life of protective clothing

(3) Discuss the four levels of personal protective clothing, when to use each, and what clothing goes with each level.

(4) Demonstrate how to properly don, doff, use, and maintain protective clothing at each level

(5) Demonstrate how to interpret a chemical compatibility chart for protective clothing.

(6) Demonstrate the maintenance, testing, and storage procedures for various types of protective clothing

f. HAZMAT control, containment, and confinement

(1) Demonstrate ability to perform advanced HAZMAT mitigation by using both chemical and physical control methods.

(2) Handle specific HAZMATs with the proper mitigation procedure from start to finish

(3) Give examples of materials used in both chemical and physical mitigation procedures, as well as how each material is used from start to finish

(4) Identify and use the proper tools for specific mitigation processes

(5) Demonstrate the ability to supervise the activities of the entry and backup teams

- Discuss selection of entry personnel

- Demonstrate selection of appropriate tools, equipment and materials for various HAZMAT mitigations

- Demonstrate communicating the mitigation plan to entry personnel

- Demonstrate ability to supervise various physical and chemical mitigations

- Demonstrate ability to assess results of mitigation efforts and to take corrective action if mitigation is unsuccessful

- Demonstrate ability to assess damages caused by the incident

- Demonstrate ability to communicate results of mitigation and assessment of damages to the Safety Officer

- Demonstrate ability to keep backup team informed

- Discuss importance of rotation of backup team members during incident

g. Decontamination (if assigned to fire department)

(1) Demonstrate ability to prepare the site and personnel for the decontamination process

- Demonstrate ability to identify the type and amount of the HAZMAT involved

- Identify and describe the advantages and disadvantages of dilution, absorption, chemical degradation, disposal, and isolation

- Demonstrate knowledge of the risks to personnel/equipment associated with decontaminating specific HAZMATs

- Discuss how various HAZMATs will react with decontamination solutions and/or materials (i.e., water)

- Discuss how to choose the test method of decontamination as well as materials to use for any specific HAZMAT

- Discuss what types of neutralizing agents are required and in what quantities for specific HAZMATs

- Discuss how to recognize symptoms of exposure to specific HAZMATs

- Demonstrate ability to select a location for the DECON site, and discuss the considerations in making selection

- Demonstrate the ability to set up a DECON site, including marking and roping, station layout, personnel protective clothing, and runoff considerations

(2) Demonstrate ability to supervise the operations of the DECON station

- Demonstrate ability to brief personnel on signs and symptoms of exposure and acute exposure

- Discuss methods and importance of medical monitoring of entry and DECON personnel

- Demonstrate ability to ensure safe operation of the DECON process

- Demonstrate ability to ensure proper practice in DECON termination activities

- Demonstrate ability to complete the prescribed documentation for DECON operations

h. Evaluate the response effort and perform termination activities

(1) Given a case, simulation or incident, demonstrate the procedures used to compare planned versus actual response efforts

(2) Write an analysis of that comparison, stating what was different, why, what immediate corrective action is indicated, and suggested ways to ensure the problems identified do not recur

(3) Describe the activities required in terminating the emergency phases of a HAZMAT incident

(4) Demonstrate ability to provide support services to cleanup personnel

(5) Discuss provision of information to the public about the incident's management

i. Perform debriefing and incident followup activities

(1) Demonstrate the ability to prepare the required reports upon termination of an incident

(2) Demonstrate ability to participate in incident debriefing

- Given a case, drill, or response experience, assess adequacy of the response plan, compare actual with planned activities, assess the outcome of the incident, and identify areas for improvement

- Lead a verbal debriefing of the incident with response personnel

- Formulate recommendations, including training, procedure changes, and policy changes as needed

- Demonstrate ability to develop and deliver training to response personnel as needed

- Demonstrate ability to restock supplies and prepare decontaminated equipment for reuse

5. Criteria for Hazardous Materials Specialist Level

The HMS must possess all the knowledge, skills, and abilities of the HMT but on a more supervisory/specialist expertise level. The HMS must be able to expertly perform all the tasks of HMT, as well as to direct and supervise the activities of the various HAZMAT response

levels. In addition, the HMS can anticipate being tasked with the role of directing the HAZMAT program. In this role, he will be responsible for planning, coordination, interagency relations, training, certification, and other facilities management tasks. Therefore, the HMS must possess the additional knowledge, skills, and abilities described below. To be eligible for basic certification as an HMS, the trainee must have performed satisfactorily for at least 3 years as an HMT on a unit involved in HAZMAT response and must have demonstrated the below listed proficiencies through a course of instruction. Proficiency for basic certification should take approximately 90 course work hours.

To be eligible for operational certification at this level, the trainee must have satisfactorily met local knowledge and ability requirements and should have performed for a period of 6 months post-course work on a unit that is involved in HAZMAT response.

a. Site management and control

(1) Demonstrate ability to confirm or expand on technician's identification of the HAZMAT by using specialized knowledge and to recognize where gaps in identification may exist or where criteria for identification may have been incorrectly used

(2) Demonstrate ability to evaluate the magnitude of hazard and risk to persons, property, and the environment

- Discuss criteria for determining whether the type and amount of spill meet statutory reporting requirements

- Identify fire, health, and building codes that require disclosure of the location and amounts of HAZMATs being used, stored, dispensed, manufactured, or transferred

- Describe federal and state regulations regarding the legal liabilities and limitations on operations during a HAZMAT incident

- Discuss criteria for determining required level or response

- Discuss criteria for notifying base commander and/or activating the response plan

- Based on the properties of the 25 HAZMAT categories, describe the safety, decision-making, and size up considerations at an incident.

- Discuss criteria for whether additional evacuation distances and zones are needed initially and due to changing conditions of the HAZMAT.

b. Incident management

(1) Discuss development of integral parts of a correct response plan

(2) Supervise the implementation of a response plan

- Demonstrate how to select and use proper specialized personal protective clothing

- Supervise containment and control operations

- Supervise the decontamination of victims and property (if assigned to the fire department)

(3) Demonstrate the ability to evaluate a safety plan specific to particular HAZMATs

(4) Discuss how to reevaluate the incident management techniques performed by the HMT

(5) Identify common problems that occur at an incident

(6) Describe how common command problems can be remedied through the use of an incident command system

(7) Identify and describe the major functional areas of an incident command system

(8) Identify and describe the command staff functions

(9) Describe how an incident command system can be expanded when responsibility for a functional area exceeds the capability of the commander

(10) Describe how an incident command system ensures unity of command

(11) Describe the common terminology of an incident command system

(12) Identify four categories of pre-incident information critical to incident operations and control

(13) Describe methods for establishing command

(14) Define authority and responsibility as they relate to the role of the HMS

(15) Describe when a command post should be established and factors important to its location

(16) Describe a procedure for transferring command

(17) Describe how to establish strategic objectives based on incident priorities, situation status, and resource capabilities

(18) Discuss the importance of clear communications to all phases of an incident

(19) Demonstrate the ability to supervise and coordinate the activities of the Safety Officer, the Information Officer, the Response Team Leader, and the DECON team leader

(20) Demonstrate the ability to coordinate onsite and offsite activities through the communications link with FCC

c. Resources

(1) Demonstrate ability to evaluate resources to identify personnel and equipment needs as conditions of the incident change

(2) Identify the technical personnel available in the response area and the limits upon them (legal, etc.).

d. HAZMAT control and containment

(1) Demonstrate ability to perform specialized control and mitigation

(2) Demonstrate ability to supervise others implementing chemical and physical mitigation techniques.

(3) Demonstrate the ability to evaluate response actions and take corrective actions

e. Decontamination (if assigned to the fire department)

(1) Demonstrate ability to supervise decontamination setup and operation

(2) Determine what types and quantities of neutralizing agents are required for specific HAZMATs

(3) Determine how much of the decontamination can be done by the response team and how much should be done by other agencies

(4) Establish a site for decontamination, and discuss criteria and requirements for that site

(5) Supervise the decontamination process, enforcing the correct safety precautions

f. Demonstrate ability to perform team safety officer functions

(1) Demonstrate ability to gather information and documentation and to maintain an incident log

(2) Demonstrate ability to formulate and implement a safety plan

(3) Discuss criteria for entry and withdrawal from the hot zone

(4) Demonstrate ability to supervise activities of the entry personnel

(5) Demonstrate ability to coordinate entry and decontamination activities

(6) Demonstrate restriction of nonqualified personnel from the hot zone

(7) Discuss maintenance of a fresh backup team for the entry team

(8) Discuss the importance of monitoring entry personnel before and after entry

g. Termination and debriefing

(1) Demonstrate the ability to evaluate termination recommendations from unit officers and take appropriate action

(2) Demonstrate ability to perform decontamination recheck

(3) Discuss provision of followup technical assistance and support to cleanup crew

(4) Discuss medical followup of response personnel

(5) Describe six elements of a report: summary, participants mentioned, actions taken, statements taken, evidence, and conclusions

(6) Given a case, incident, or simulation, prepare a narrative report on an emergency incident with recommendations to prevent recurrence of problems encountered

(7) Demonstrate how to supervise the maintenance, testing, and storage procedures of the personal protective clothing

(8) Demonstrate ability to translate results of postaction assessments into training, changes in procedures, and changes in policies

h. Administration, certification, planning, and training

(1) Demonstrate ability to write a response plan

(2) Demonstrate ability to write mutual aid agreements

(3) Demonstrate ability to forecast and plan for material and personnel needs

(4) Demonstrate ability to forecast and plan for training needs

(5) Demonstrate knowledge of certification criteria and procedures

6. Listing of Possible Local Criteria for Certification of Responders

First Responder, Awareness Level

a. Demonstrate familiarity with local agreements, plans, policies, and procedures and with

(1) Local response plan

(2) Local mutual aid agreements

(3) Local HAZMAT response standard operating procedures

(4) Other pertinent local documents

(5) Local frequencies, phone numbers, and reporting procedures

(6) Local command structure for HAZMAT operations

(7) State and local regulations and laws which must be complied with in HAZMAT operations

(8) Local evacuation plans and routes

b. Demonstrate familiarity with local conditions critical to HAZMAT response and with

(1) Locations and types of HAZMATs on station

(2) Locally available reference materials, including where MSDS, are posted

(3) Local geographic, demographic, and meteorological conditions which may impact on HAZMAT responses

(4) Local utilities layouts and utilities contact persons which might impact on HAZMAT operations

(5) Special local hazards which might impact on HAZMAT responses

(6) Special vulnerabilities of persons, property and environment in the local area

First Responder, Operational Level

The FRO is responsible for the same local factors as the FRA plus the following:

c. Demonstrate familiarity with the locally available equipment used in HAZMAT operations

(1) Demonstrate use, troubleshooting, and maintenance of personal protective clothing

(2) Demonstrate use, troubleshooting, and maintenance of local mitigation equipment

(3) Demonstrate use of local reference sources and data bases

(4) Demonstrate use of DECON equipment

Hazardous Materials Technician Level

The HMT is responsible for the same factors as the FRA and FRO, plus the following:

d. Demonstrate ability to perform leadership activities within the local command structure for HAZMAT operations

(1) Demonstrate familiarity with local constraints on normal HAZMAT operations

(2) Demonstrate familiarity with the qualifications and abilities of FRA, FRO, and HMT personnel in the response unit

(3) Demonstrate familiarity with criteria for activating mutual assistance plans

(4) Demonstrate ability to comply with local documentation and reporting requirements

Hazardous Materials Specialist Level

The HMS is responsible for the same factors as the FRA, FRO and HMT plus the following:

e. Demonstrate familiarity with local conditions impacting on facility and unit management

- (1) Constraints of local funding
- (2) Local political considerations
- (3) Manning levels
- (4) Trends in HAZMATs onstation
- (5) The AF role in HAZMAT support of the community
- (6) Factors impacting long-range planning of the response unit

E. TRAINING COURSE OUTLINES FOR HAZMAT RESPONDERS

This section sets forth outlines of courses that should constitute AF HAZMAT responder training. These outlines are based on the training requirements and certification standards outlined in this section. Where possible, courses are incorporated in their entirety, with notations of additions or deletions that should be made. Courses on supervision and leadership are not closely scrutinized. Even though this is a part of the HAZMAT supervisors' jobs, it is also part of any fire department supervisor's job and, thus, not domain specific. In addition, this outline cannot cover all of the specific AF practices, procedures, or equipment, because standardization has not fully emerged in those areas.

1. First Responder, Awareness Level

The USAF advanced course for "Munitions/Hazardous Materials Firefighting" meets virtually all of the training and certification requirements for FRA. The following additions are needed.

a. Recall the HAZMATs most likely to be found on a base and where they are likely to be located

A short unit can be added to the USAF course covering this requirement developed from the general HAZMAT inventory of materials and from firefighter experience. Each material should be listed in MSDS

format, expanded to include what the material is usually used for, where it is likely to be located on a base, where local documentation on its statistics will be found, and any special marking that will help identify it.

b. Describe the NFPA "General Hazardous Material Behavior Model" and "Basic Events Interruption Principles"

The model is contained in the NFPA "Hazardous Materials Incident Analysis" course on which the USAF course is based in part. This can be added very easily.

c. Describe the types of specialized marking systems found at fixed facilities on bases.

This material can also be added to the USAF course with the listing of HAZMATs most likely to be found on a base.

d. List criteria for a safe staging area

e. Discuss use of staging area to control site access to authorized personnel.

Control of site access has been covered in the USAF course; however, more explicit coverage of siting a staging area may be needed. Materials available for evaluation referenced information that covers staging criteria but did not directly mention them. Course instructors should be consulted to see whether this material is present in the course.

The AF course is based on NFA's "Recognizing and Identifying Hazardous Materials" and on "Hazardous Materials Incident Analysis." As such, it represents the best non-Air Force option for teaching the FRA.

The USAF course "Munitions/Hazardous Materials Firefighting" should be used as the critical course for basic certification of FRAs with the minor modifications listed above. In addition, some practice should be included in actually donning protective clothing (if it is not already provided in the basic firefighter training), and there could be some drills in which trainees approach and identify. Also there needs to be some drills in the basic containment methods that are outlined in the teaching guide. It is also recommended that the AF base fire operations simulator at Chanute can be used to run simulated incidents for FRA trainees to take part in.

2. First Responder, Operational Level

The Phoenix, Arizona, Fire Department's "HMT-160 Training Program" essentially meets all of the requirements for training at this level. HMT-160 is outlined in Appendix O. It goes beyond the scope of the FRO with a couple of units, which can be eliminated without disrupting the continuity of the rest of the course. There are some areas that

HMT-160 does not cover or which the AF should modify to more closely conform to AF requirements and practices. These are listed below. Also, the portions of HMT-160 that are beyond the scope of FRO are listed. These are applicable at the HMT level, however, and could be considered for that purpose.

Criteria not covered or needing modifications for AF needs.

a. Personal protective clothing

HMT-160 gives thorough coverage on this subject, but the training equipment might not match that used by AF. AF trainers should evaluate this and tailor the protective clothing and equipment training to what the AF is using.

b. Demonstrate ability to use HMIMS (or other computerized incident management data base)

Any data base the AF adopts will require training.

c. Demonstrate the ability to use a radio to pass information and seek advice from experts

d. Explain FRO responsibilities when responding to a HAZMAT incident

This should be tailored to AF policy.

e. Given radio frequencies, demonstrate how to set them up with the response team and describe key personnel to which information should be disseminated

This should be tailored to AF equipment and policy.

f. Describe how to perform both physical and chemical mitigation

These subjects receive some coverage in HMT-160. However, AF trainers should evaluate content to determine whether this coverage is adequate.

g. Demonstrate familiarity with aircraft HAZMAT incidents

HMT-160 does not cover this subject; it should be tailored to AF aircraft characteristics and the types of HAZMAT normally found in and around them.

h. Demonstrate familiarity with HAZMAT incidents at fixed facilities normally found on AF bases

Fixed facilities are covered somewhat; however, AF trainers should evaluate the adequacy of this coverage and should tailor it to

reflect AF facilities. As an example of this, civil fire departments do not normally have to contend with ordnance depots.

i. Demonstrate familiarity with pipeline HAZMAT incidents

HMT-160 does not cover pipelines. The AF should evaluate whether it needs to cover this area as a general course subject or as a special area just for certain bases.

Content not required for FRO:

(a) Basic HAZ-CAT Chemical I.D. System* - one day

(b) Advanced HAZ-CAT Chemical I.D. System - one day

Air Force may not use HAZ-CAT; if it uses this system or one similar, its use is more appropriate for the HMT.

(c) Air Monitoring Equipment and Practices - one day

AF may use different equipment; this responsibility probably will not be FRO's but HMT's. Recommended for HMT, after tailoring to AF equipment.

(d) Interagency Responsibilities in HAZMAT Response - one day

This is not likely to reflect AF practice; the content is for HMT/HMS personnel.

The AF may elect not to teach chemistry to FROs at quite the level of detail that these courses provide. While this information is essential to the HAZMAT response, the AF may elect to reserve this training to the HMTs. This material may be too difficult for some FRO trainees.

The Fire Training Center (Sacramento, Calif., State Fire Marshall's Office, State of California) offers four 40-hour courses that appear to cover the bulk of the requirements for FRO. They are HM 1A "Properties of Hazardous Materials," HM 1B "Hazardous Materials Safety Considerations," HM 1C "Assessing Hazardous Materials Emergencies," and HM 1D "Procedures for Handling Hazardous Materials Emergencies." As with HMT-160, they would require careful assessment and tailoring to AF needs. The California courses do have sections on pipeline incidents and on aircraft incidents.

NFA Courses also cover the material for FRO. Two courses, "The Chemistry of Hazardous Materials," and "Hazardous Materials Tactical

*Phoenix Fire Department, telephone (602/262-6297), may be contacted for more information.

Considerations," with a combined length of 160 hours, appear to cover the materials well, with limitations similar to those of HMT-160. Again, AF would need to tailor this material to AF equipment and policy. Also, it would require addition of material on aircraft and munitions. NFA have indicated a willingness to train AF trainers for these and other courses. Again, the AF may elect to reserve the advanced chemistry to HMTs; if this is the case, experts in the chemistry of HAZMATs would need to determine how much chemistry FROs need and develop the content accordingly.

The Phoenix, Arizona, Fire Department's program has been recognized by the State of Arizona as criteria for HAZMAT responders with technical response assignments. The chemistry portion of this course appears to be closely based on NFA's chemistry course. There are AF facilities in Phoenix that are probably adequate or could be developed to house an advanced HAZMAT program. On the other hand, NFA courses taught at Chanute would offer the advantage of centralization of AF HAZMAT training at the AF Fire Training facility. Also, NFA offers other courses geared for HMT and HMS personnel, which could be incorporated at Chanute.

Both Phoenix and NFA should be considered by AF. If the advanced chemistry and monitoring material is removed from FRO training for initial certification, it can be added later to meet continuing training requirements for FRO, then used as a prerequisite for entering HMT training. This would have the advantage of meeting two training requirements with one class so that little additional intensive specialized schooling would be needed to transition to HMT by the time the firefighter has completed the time in grade requirements. This could be accomplished by breaking the HMT requirements into natural units of 3 to 5 days and then sending FROs to training or bringing it to them on an annual basis. Another continuing training course FROs should be required to take before entering HMT training is the NFA's "Hazardous Materials: The Pesticide Challenge."

3. Hazardous Materials Technician Level

It is assumed that HMT candidates will have received training to prepare them for incident command, such as NFA's "Preparing for Incident Command" and "Commanding the Initial Response." Because the HMT will be working in a supervisory capacity, preparation of this sort is suggested. In fact, AF is teaching these two courses at Chanute. In addition, coursework such as NFA's "Instructional Techniques for Company Officers" is recommended as HMTs will be charged with teaching others how to use specialized equipment and perform specialized operations. This will be particularly important if AF elects to teach prerequisite courses at the local bases instead of at Chanute (saving transportation and per diem expenses).

The HMT needs to have a more detailed knowledge of chemistry, monitoring, and toxicology than that required for the FRO. Similarly, the HMT must have a better knowledge of command and control, of tactics

and strategy, and of interagency cooperation. The HMT also must be trained to use the HAZMAT software adopted by the AF. There are two ways this might be accomplished, depending on whether or not the chemistry, monitoring, toxicology, and interagency cooperation material is left in FRO course content.

If the coursework for FRO retains the chemistry, toxicology, monitoring, and interagency cooperation outlined above, it will contain virtually all of the technical content that the HMT will need. The finer detail on chemistry, toxicology, monitoring, and interagency cooperation can come from a review of the same basic courses taught at FRO level. The principal reason no new training in these areas would be required is that by the time the trainee is in HMT coursework, he will have learned the material and applied it. Material learned in this manner and reviewed is likely to be better understood because of the element of experience. About 2 years would elapse between FRO certification and HMT certification and as the HMT will be heavily responsible for the safety of others, an annual 2-week review of the material would be recommended as part of the HMT training. The software training can be delivered as continuing training during FRO time in grade.

If that body of material were removed from FRO training (they would still require some chemistry, some toxicology, and perhaps some monitoring), it could be offered as continuing training required of FROs with the software training and prerequisite to entering training for HMT certification.

About the only material the HMT will need that the FRO has not been taught, other than the software training, is the supervisory and training material described above. In addition, the NFA course, "Command and Control of Fire Department Operations," is recommended. It is recognized that this course is not specifically targeted at HAZMAT responders, though it does contain an important section on HAZMAT. At this level of training, it is difficult to separate non-HAZMAT supervisors from HAZMAT supervisors in the command structure and in the conceptual tools that they need. In fact, it might be most effective for the AF to predicate attaining supervisory responsibilities in fire protection on completing HAZMAT certification. The course should not be accepted without critical evaluation, however, to ensure that the material is relevant to the AF command structure and to AF practice.

If the advanced units of HMT-160 are used for FRO continuing training, HMTs will have received most of the technical training they need during training for FRO; however, they will need to review that training. At a minimum, HMTs need a thorough review and retesting on the chemistry and toxicology taught at the FRO level. In addition, they need an in-depth course or review on monitoring equipment such as the section from HMT-160 or from NFA's "Hazardous Materials Tactical Considerations," as well as a review of tactics and strategy and training in the use of the HAZMAT software systems the AF adopts. The NFA course on "Command and Control" is recommended, as well, modified to fit AF command structure and procedures. Because HMTs will lead less

experienced personnel in major operations, they should also have a curriculum of field exercises at levels more advanced than for FROs. Accordingly, it is recommended that they be sent periodically to programs such as those offered by Texas A&M "Tank Truck Emergency Response, Oil Spill Control," by the Transportation Test Center of the Association of American Railroads "Intermodal Emergency Response Course, Tank Car Safety Course," and by EPA "HAZMAT Incident Response Operations" so they can get extra training in hands-on response.

A better alternative for hands-on drills would be for the AF to develop these courses at Chanute and to use them to meet continuing training requirements. The fire operations simulator could also be used for this purpose. Completion of these additional courses could be a criterion for entering training as an HMS. An advantage of having these facilities at Chanute is that it would allow the integration of hands-on training at several levels. For instance, in one drill, FRA trainees could be observers, while FRO trainees suited up and performed control operations under the direction of HMT trainees. All three groups would potentially benefit.

4. Hazardous Materials Specialist Level

The primary difference between HMS and HMT is that transitioning from one to the other moves the firefighter from first-line supervisor to manager. Considerations of planning and facility management become paramount. HAZMAT subject matter which the HMS needs that is not required of the HMT includes training in making and evaluating incidents response plans and mutual assistance agreements. Here, there is considerable overlap with conventional fire protection management to the point that the AF does not yet have much formal policy on interagency agreements, and no training in that area is offered beyond informal discussion in the "Advanced Fire Protection Technology" course. Another subject that needs attention is that of activating the mutual assistance agreement. All of these can be readily incorporated in Advanced Fire Technology, but outlining and developing the content must await AF policy development. These concerns are addressed in FEMA/Emergency Management Institute's "Integrated Emergency Management Course," and "Emergency Management, U.S.A." courses. The HMS needs to be skilled at directing, critiques of incidents and incorporating changes into training, policy, procedures, and agreements, and in the policy and procedure of certification. Again, here the distinction between HAZMAT and non-HAZMAT is blurred.

There are two areas where HAZMAT-specific training is needed. One area is assessment of hazard and risk in the evacuation of nearby populations. Thus, some skill in projecting the spread of HAZMAT by natural means (wind, weather, gravity, etc.) is needed. The trainee will have already learned about the behavior of various HAZMATs in earlier training; only a review should be needed. If the AF adopts a plume modeling program, then it should also be part of the training. Another area which might require additional training is the responsibilities as the team safety officer. While most of the material the

team safety officer must know will have already been learned in HMT training, a review of much of the material is advised. EPA's "Response, Safety, Decision-Making Workshop" is geared to needs of the team safety officer. It includes a unit on safety plans. Both documentation and the general content of safety plans are covered in FRO training, and this unit could consist primarily of review. This, too is an area in which case studies or simulations would be of more value than simple classroom instruction.

Because the distinction between HAZMAT and non-HAZMAT is so slight, a unit of material can be added to the Advanced Fire Protection Technology course to address the concerns outlined above. A case-study approach would probably be most effective approach in teaching the critique material in much the same way that case studies are used to teach complex material in Master of Business Administration courses. The material for this unit should be developed specifically for AF HMS training, as it needs to be tailored to AF policy, practice, and conditions. An NFA course, "Strategic Analysis of Fire Department Operations," is available on which much of that unit could be based. Again, this is not a course specifically tailored for HAZMAT personnel but one geared to managers of both HAZMAT and non-HAZMAT responders. It is case study oriented. In addition, this unit should include the EPA course material, "Response Safety Decision-Making."

Recommended courses in this section are listed in Appendix M.

SECTION V

HAZMAT INFORMATION MANAGEMENT SYSTEM

A. INTRODUCTION

The objective of this project is to develop a user-friendly computer system that provides information for response during accidents involving HAZMATs, including the development of HAZMAT program elements for use by the USAF fire protection community. Software operating instructions and user documentation also will be provided. The new information system will be known as the Hazardous Materials Incident Management System (HMIMS). The HMIMS is intended for installation at AF bases with applications to include the bases and surrounding vicinities. Primary operations will be centered in AF base fire departments.

The following criteria and justification have been developed for a computerized incident management system compatible with the HAZMAT inventory system. The approach consists of determining the needs of the AF, identifying software and hardware systems requirements, evaluating existing software and hardware, and describing the recommended system.

This development will draw upon and enhance existing software systems and data bases available in proprietary, commercial, and public domain systems, including potential sources of software and data bases within the AF. Numerous available software systems were evaluated in terms of their potential to serve the functional software requirements of HMIMS. A subset of the most suitable commercial and public domain software systems was identified and reviewed for functional characteristics. Each system was evaluated individually, and one was selected as the most appropriate. This section presents a justification for the selected system including background and rationale for the procedures, methodology, and logistics of HMIMS.

B. JUSTIFICATION

The primary justification for the development of HMIMS derives from a number of laws enacted by the U. S. Congress that mandate a comprehensive and coordinated program for management of potential HAZMAT emergencies. These laws include the National Environmental Policy Act, Toxic Substances Control Act, Resource Conservation and Recovery Act, Comprehensive Environmental Responses Compensation and Liability Act, and Superfund Amendments and Reauthorization Act, and Occupational Safety and Health Administration regulations.

To fulfill its mission and to comply with the Congressional mandate, the AF has determined that the responsibility for initial response and coordination of HAZMAT incidents at each AF base shall reside in the base fire department. The AF/LEE letter stated, "Today's widespread use

of HAZMATs at AF bases has increased the likelihood of the materials becoming involved in a fire, spill, or leak. The fire department's around-the-clock capability to deal with emergency situations makes their involvement in such incidents a natural occurrence" (letter to all major commands, 16 December 1985).^{*} This charge makes it imperative that the AF fire protection community should have a program for preparing itself to prevent HAZMAT incidents and for responding to the incidents that do occur.

To be effective HMIMS must incorporate the features desired by AF base fire department personnel. During the first phase of this project personnel visited AF bases to discuss the computerized incident management system needs and requirements. The consensus among fire department personnel at all four bases is that HMIMS is needed.

C. FUNCTIONAL REQUIREMENTS FOR HAZARDOUS MATERIAL INCIDENT MANAGEMENT SYSTEM

The first response to a HAZMAT incident on an AF base is typically made by the base fire department and has three phases: approach, containment and control, and transfer of responsibility for the controlled emergency to the authority in charge of long-range resolution. The person leading the initial HAZMAT response might be the Base Fire Chief or Assistant Chief. In this section this person will be referred to as the Senior Fire Officer (SFO). The functional requirements are defined as those software features and databases that will enable the SFO to better execute a safe approach, to improve containment and control, and to provide a protocol for orderly transfer of command at the conclusion of the emergency. The system must be a tool that expands the SFO's ability to quickly access pertinent data and provides support for decision making. The system must be an integral part of normal operations rather than an additional activity that detracts from normal operations during an emergency.

The HMIMS objectives are:

1. To use existing commercially available data bases and software to the maximum.
2. To provide easy access to the data base and to facilitate modification and updating of data.
3. To provide a user-friendly command interface for use by personnel who are not trained as computer scientists or programmers.

^{*}See footnote in Section 11B.

4. To provide access to the following types of information directly from the main menu:

- a. Inventories
- b. Floor plans
- c. MSDSs
- d. Utility disconnects
- e. Special safety concerns
- f. Protocols
- g. Plume model.

5. To ensure compatibility and interface with the Wang microcomputer systems already adopted by the AF.

6. To provide a stand-alone system with capabilities for network linkages to Wang mainframe.

7. To ensure adequate speed and memory to meet the needs of fire departments during real emergencies.

8. To provide a compact workstation with minimal space requirements.

9. To provide a system which is cost effective for distributed processing on work stations at fire departments and remote command posts.

10. To provide a system that enhances training activities for HAZMAT incident response.

In summary, the functional requirements of HMIMS are extensive because the system must develop, access, update (edit), and display data characterizing HAZMATs as well as geographic data that represent the locations of HAZMATs, facilities, and emergency management resources. The development effort must provide a system that the AF can implement to stabilize, control, and cleanup HAZMAT incidents. The prototype generic HMIMS will include a computerized inventory file that will allow the fire department operator to establish and maintain data regarding the status of HAZMATs at each AF base. These data should be accessible by federally listed NSNs for certified equipment, materials, and clothing items. The system must provide for dissemination of data to all responsible agencies for use in their HAZMAT Incident Management Program.

D. SOFTWARE SELECTION

This review covers a wide range of software, including systems specifically designed for emergency management at chemical manufacturing and/or storage sites and other systems with generic capabilities which may support emergency management needs but which are not specifically designed for emergency management. Numerous retrieval systems for data describing HAZMATs are available, but the existing systems do not meet the comprehensive requirements of HMIMS.

The greatest shortcoming of all existing HAZMAT and emergency management systems is in the treatment of geographic information. The HMIMS must be accepting digital cartographic data regarding base facilities. In particular, it is advised that the Base Comprehensive Plans (BCP), maintained by AF bases CEs, be the official data base of record upon which all emergency operations and other base operations depend for cartographic and other geographic information about AF bases facilities. The preparation and maintenance of a BCP is a standard operating procedure for all AF bases. For most AF bases the BCP exists as a collection of hardcopy maps, but numerous bases now have digital cartographic files representing the content of the hardcopy maps. Headquarters USAF has endorsed and encouraged development of digital BCP data bases as well as hardcopy maps by architect/engineer firms contracting to provide BCP services to the AF.

Of 38 systems evaluated, Emergency Information System/Chemical (EIS/C) by Research Alternatives, Inc., was found to have the most comprehensive combination of HAZMAT data and map display functions (Tables 5 and 6). Its primary shortcomings are in the area of geographic information processing, and this needs to be strengthened to meet HMIMS goals. A detailed discussion of the evaluation follows.

1. HAZMAT Databases

All manufacturers, distributors, and users of HAZMATs are required to provide a prescribed list of information describing each substance in terms of flammability, reactivity, and health characteristics; special precautions; protective clothing and equipment requirements; and ventilation requirements in MSDSs. They are available in computer readable form and are the basis for all of the thematic database systems evaluated in this project. The various systems differ primarily in the selection as to which materials are included and in the procedures used to access MSDS records. It is essential to keep in mind that the hazards listed on each MSDS record deal only with that chemical in its pure form. Hazards associated with mixtures of chemicals that come into contact during an incident, particularly during a fire, can be extremely dangerous, but no current system deals with the problem of mixtures.

The total number of MSDS records is quite large. Most systems limit their coverage to a few thousand records to improve efficiency,

TABLE 5. SOFTWARE SYSTEMS EVALUATED FOR HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM.

WISC Risk Category	Site	Atmospheric Dispersion Model	450S Data Base Model Results	450S Retrieval Status	Mapping	GIS Basemap Layer	Inventory Database
	113	X	X 2 3 4 AMEC	X	X		X
	114	X	X 2 3 4	X	X		X
	115	X	X 2 3 4	X	X		X
	116	X	X 2 3 4	X	X		X
	117	X	X 2 3 4	X	X		X
	118	X	X 2 3 4	X	X		X
	119	X	X 2 3 4	X	X		X
	120	X	X 2 3 4	X	X		X
	121	X	X 2 3 4	X	X		X
	122	X	X 2 3 4	X	X		X
	123	X	X 2 3 4	X	X		X
	124	X	X 2 3 4	X	X		X
	125	X	X 2 3 4	X	X		X
	126	X	X 2 3 4	X	X		X
	127	X	X 2 3 4	X	X		X
	128	X	X 2 3 4	X	X		X
	129	X	X 2 3 4	X	X		X
	130	X	X 2 3 4	X	X		X
	131	X	X 2 3 4	X	X		X
	132	X	X 2 3 4	X	X		X
	133	X	X 2 3 4	X	X		X
	134	X	X 2 3 4	X	X		X
	135	X	X 2 3 4	X	X		X
	136	X	X 2 3 4	X	X		X
	137	X	X 2 3 4	X	X		X
	138	X	X 2 3 4	X	X		X
	139	X	X 2 3 4	X	X		X
	140	X	X 2 3 4	X	X		X
	141	X	X 2 3 4	X	X		X
	142	X	X 2 3 4	X	X		X
	143	X	X 2 3 4	X	X		X
	144	X	X 2 3 4	X	X		X
	145	X	X 2 3 4	X	X		X
	146	X	X 2 3 4	X	X		X
	147	X	X 2 3 4	X	X		X
	148	X	X 2 3 4	X	X		X
	149	X	X 2 3 4	X	X		X
	150	X	X 2 3 4	X	X		X
	151	X	X 2 3 4	X	X		X
	152	X	X 2 3 4	X	X		X
	153	X	X 2 3 4	X	X		X
	154	X	X 2 3 4	X	X		X
	155	X	X 2 3 4	X	X		X
	156	X	X 2 3 4	X	X		X
	157	X	X 2 3 4	X	X		X
	158	X	X 2 3 4	X	X		X
	159	X	X 2 3 4	X	X		X
	160	X	X 2 3 4	X	X		X
	161	X	X 2 3 4	X	X		X
	162	X	X 2 3 4	X	X		X
	163	X	X 2 3 4	X	X		X
	164	X	X 2 3 4	X	X		X
	165	X	X 2 3 4	X	X		X
	166	X	X 2 3 4	X	X		X
	167	X	X 2 3 4	X	X		X
	168	X	X 2 3 4	X	X		X
	169	X	X 2 3 4	X	X		X
	170	X	X 2 3 4	X	X		X
	171	X	X 2 3 4	X	X		X
	172	X	X 2 3 4	X	X		X
	173	X	X 2 3 4	X	X		X
	174	X	X 2 3 4	X	X		X
	175	X	X 2 3 4	X	X		X
	176	X	X 2 3 4	X	X		X

Source: Information and Demonstration Software provided by lenders

TABLE 6. INFORMATION ON SOFTWARE SYSTEMS EVALUATED FOR HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM.

<u>Name</u>	<u>Company</u>	<u>Computer Compatibility</u>
EIS	Research Alternatives 966 Hungerford Dr. Rockville, MD 20850	IBM PC
CAMEO	Envirotech Operating Services One Waters Park Dr. San Mateo, CA 94403	Apple
GENESIS - HEXXIS	Hexxis, Inc. 14755 Preston Rd. Dallas, TX	Wang
CHEMTREC - CHEMNET	Chemtrec / CMA 2501 M Street, N.W. Washington, D.C. 20037	N/A (dial-up)
HAZARDLINE	Occupational Health Services, Inc. P.O. Box 1505 400 Plaza Drive Secaucus, NJ 07094	
Digital HAZMAT	Spumifer American Co. P.O. Box 3267 St. Augustine, FL 32085-3267	IBM PC
CHEMDATA	Aqua Tech, Inc. 140 South Park St. Port Washington, WI 53074	IBM PC
FLOW II GEMINI	General Research Corp. 7655 Old Springhouse Rd. McLean, VA 22102	IBM, VAX
HMIS	Defense Logistics Agency Cameron Station Alexandria, VA 22304-6100	IBM PC
ONS MSDS	Occupational Health Services, Inc. 450 Seventh Ave. New York, NY 10123	IBM PC
Phoenix Fire Dept.	Phoenix Fire Dept. 620 West Washington Phoenix, AZ 85003	PDP-11

TABLE 6. INFORMATION ON SOFTWARE SYSTEMS EVALUATED FOR HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM (CONTINUED).

<u>Name</u>	<u>Company</u>	<u>Computer Compatibility</u>
CERIS	Management Logistics Intl. Ltd. 1401 Wilson Blvd. Arlington, VA 22209	IBM PC
SAFER	SAFER Emergency System Barley Mill Plaza Wilmington, DE 19898	N/A (microcomputer part of system)
PC MIDAS	Pickard, Lowe and Garrick, Inc. 1615 M Street, N.W. Washington, D.C. 20036	IBM PC
CHARM	Radian Corp. P.O. Box 201088 Austin, TX 78720-1088	IBM PC
MESOCHEM	Impell Corp. 455 North Wiget Lane Walnut Creek, CA 94598	IBM PC
AFTOX	Air Force Geophysics Laboratory Atmospheric Structure Branch Hanscom AFB, MA 01731-5000	Zenith
HARM	Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, TN 37831	VAX
DEGADIS	Department of Chemical Engineering University of Arkansas 3202 Bell Engineering Center Fayetteville, AR 72701	VAX
ARAC	Lawrence Livermore National Lab. P.O. Box 808 Livermore, CA 94550	VAX
DWNWND	Oak Ridge National Laboratory P.O. Box 2008 Oak Ridge, TN 37831	PDP-10
BREEZE HAZ	Trinity Consultants, Inc. 100 North Central Expressway Richardson, TX 75080	IBM PC

TABLE 6. INFORMATION ON SOFTWARE SYSTEMS EVALUATED FOR HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM (CONTINUED).

<u>Name</u>	<u>Company</u>	<u>Computer Compatibility</u>
D2PC	Chemical Research Development and Engineering Center Aberdeen Proving Ground, MD 21010-5423	IBM PC
SAFETI & WHAZAN	Technica, Inc. 355 East Campus View Blvd. Columbus, OH 43235	IBM PC
CHEMTOX	VNR Information Services 115 Fifth Ave. New York, NY 10003	IBM PC
CHIT - TOXIC ALERT	The Marcom Group, Ltd. P.O. Box 9557 Wilmington, DE 19809-9557	IBM PC
SAF-T MANAGER	J. T. Baker Chemical Co. 222 Red School Lane Phillipsburg, NJ 08865	IBM PC
FIRSTsystem MicroCHRIS (USCG) MicroOHM/TADS (EPA)	FIRSTsystems 134 Middle Neck Rd. Great Neck, NY 11021-1246	IBM PC
MSDS, Inc.	MSDS, Inc. 2674 East Main St. Ventura, CA 93003-2899	IBM PC
SAFECHEM II	Safeware, Inc. 4677 Old Ironsides Dr. Santa Clara, CA 95054	IBM PC
AHMRTS	Naval Safety Center Naval Air Station Norfolk, VA 23511-5796	IBM PC
TOXNET	National Library of Medicine Specialized Information Services Bethesda, MD 20894	N/A (dial-up)
HAZMIN-C	Logical Technology, Inc. P.O. Box 3655 Peoria, IL 61614	Apple

TABLE 6. INFORMATION ON SOFTWARE SYSTEMS EVALUATED FOR HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM (CONCLUDED).

<u>Name</u>	<u>Company</u>	<u>Computer Compatibility</u>
HazKNOW	HazMat Control Systems, Inc. 5595 East Seventh St. Long Beach, CA 90804	IBM PC
FireSoft	Public Service Computer Software, Inc. 1220 L Street, N.W. Washington, D.C. 20005-4018	IBM PC
HASTE	ERT 696 Virginia Rd. Concord, MA 01742	IBM PC
FRES	Weston 955 L'Enfant Plaza, S.W. Washington, D.C. 20024	IBM PC
CHEMIS	BEC 1130 West Pender Vancouver, B.C. Canada V6E 4A4	information not available

and they focus on the most appropriate substances for a given type of facility. A total of 19 different MSDS databases were evaluated (Table 5). They ranged from the CHEMTREC/CHEMNET database with more than 90,000 substances to the SAFECHEM II database with only about 1,000 substances. The EIS/C data base contains 2,629 substances; the list is identical to that contained in the CAMEO system (References 13 and 14), which is a public domain system developed by the NOAA specifically for use by a fire department.

It was concluded that the MSDS database for HMIMS should be a resident database on digital storage medium. All of the databases containing 2,500 or more substances are considered to be a sufficient foundation for HMIMS with the understanding that, in any case, additional substances specific to AF facilities will have to be added as the development proceeds at each AF base. Procedures will be available for adding MSDSs received from manufacturers and from other sources found to be more informative. The CDROM version of the DOD's HMIS database will be made available as a standard feature of the HMIMS system.* Several large network databases can be accessed for updating and increasing the HMIMS information. These systems should not be depended upon for real-time emergency operations, especially at remote workstations, as they would present a potential problem regarding both access time and security/reliability of the link.

2. Inventory Databases

Several inventory database systems were identified. These systems are designed specifically to manage inventory data accounting for facilities, locations, and contents (Table 5). While each of these may function quite well as a stand-alone system, there is a distinct advantage to other inventory database systems that are already integrated into more comprehensive emergency management systems.

3. Emergency Management Systems

Emergency management systems are highly specialized application systems involving several different information technologies. At the microcomputer workstation level, only two systems offer a significant subset of the features required for HMIMS (Table 5). The CAMEO system developed by NOAA and the EIS/C system developed by Research Alternatives, Inc., are quite similar because EIS/C is a commercial modification of CAMEO. The advantage of EIS/C is that it has been modified to run on IBM microcomputers and is therefore compatible with the Wang microcomputers already adopted and readily available in the AF. CAMEO is primarily oriented toward the Apple family of microcomputers.

*USAF Occupational and Environmental Health Lab/ECH, Attn: Anna Willis, Brooks AFB TX 78235-5501, Autovon 240-3214 or 512/536-3214.

4. Geographic Information Systems

While the HMIMS system should not be construed as a GIS, it clearly requires some characteristic GIS functions. In particular the software must be capable of representing the location and geometric form of cartographic objects. Buildings, streets, and other base facilities must be converted from analog drawings to digital spatial databases with geometry and attributes. The analytical software must be capable of representing the distribution of each geographic phenomenon, spatially registering geographic distributions from different sources, and identifying coincident locations on multiple databases. For example, it may be necessary to determine the location of a fire or other danger, define a zone of risk surrounding the fire, intersect the zone of risk with the location of chemical stores, and estimate the population at risk from the chemical threat. All of these functions are geographical, because they emphasize location and movement in space.

The most important GIS function required by HMIMS is the conversion and transfer of data from the BCE's database of record (floor plans, utilities, facilities, etc.) to the fire department's microcomputer workstation environment.

Sophisticated GIS capabilities are now available in several commercial and public domain software systems. ORNL geographic software was chosen because it is: (a) the most comprehensive of the available GIS software systems, (b) compatible with the Wang microcomputer systems, and (c) nonproprietary. It has been used previously in emergency management applications. It is complementary with the EIS/C system, and there is little redundancy between the two systems. The development effort will selectively adapt portions of the ORNL software for incorporation into the HMIMS.

5. Air-Diffusion Models

The HMIMS must be capable of modeling the dispersion of airborne chemical releases. A total of 14 different atmospheric dispersion models were evaluated. Of these 14, eight were found to have satisfactory mapping capability associated with the resulting plumes of atmospheric release.

Air-diffusion models, like other models that simulate the movement of fluids in three dimensional space, are faced with severe tradeoffs between speed, precision, and detail in the characterization of ambient conditions. Improvement in precision tends to increase the run time for the model. To include certain ambient conditions (e.g., the actual land surface form and terrain of the flow path) can increase run time so drastically as to be prohibitive. Models designed for long-range planning and environmental analysis and models intended for use on large, fast computers can function at high precision and detail. Models designed for rapid response and for use on personal computers must sacrifice precision and detail to achieve feasible run times. In general, the best models for this purpose are puff models, which simulate

the movement of air as a series of discrete puffs. The USAF-developed Chemical Dispersion Model (AFTOX)* represents a reasonable choice for incorporating into HMIMS.

6. Graphic Systems

Seven graphic systems were considered for features that would significantly enhance HMIMS beyond graphics features available in more general software systems. Of the seven systems studied, none were found to have any particular advantage over the more comprehensive systems. There is, in fact, a distinct advantage to the use of graphics software that is already integrated into a more comprehensive emergency management system or GIS.

7. Evaluation and Selection

For the development of AF HMIMS, the best integrated software EIS/C was chosen as a basis to build upon. After software research and field interviews, the system provided the desired characteristics, which were the major reasons for its selection. Reasons for its selection are cited below.

a. Of the 38 systems evaluated in Table 5, the one which provides the most complete list of features compatible with AF microcomputer systems is EIS/C.

b. EIS/C contains a reasonably complete database of MSDS records to serve as a foundation for HMIMS.

c. It offers an attractive list of features for emergency management at chemical installations.

d. It is compatible with existing microcomputer hardware systems already adopted by the AF.

e. EIS/C is a menu-driven system, well-designed for ease of use by nonprogrammers.

f. It includes an inventory database management system.

g. It is the most cost-effective system with the already integrated database files.

h. It has been developed and field-tested (Pennsylvania State Emergency Management Agency adopted and tested EIS/C).

*Contact: Bruce Kunkel, AFGL/LYA, Hanscom AFB, MA 01731, 617/377-2972.

E. HAZARDOUS MATERIALS INCIDENT MANAGEMENT SYSTEM DEVELOPMENT

The selected software system and databases should be integrated into the unified HMIMS framework with emphasis on ease of use, rapid response, and comprehensive coverage of emergency managers' needs. HMIMS must provide rapid access to map images and other spatial databases characterizing base facilities including buildings, utility lines, transportation networks, and emergency resources. The principal sources of such information should be BCP Tab Series, hard copy maps and engineering drawings, and digital line graphs. EIS/C will provide a fundamental MSDS database, storage, and retrieval system with map graphics, and other emergency management features. The Computing and Telecommunications Division at ORNL will enhance the geographic information processing capabilities of EIS/C for incorporation into HMIMS. Project personnel will recommend procedures for implementing, processing, and exchanging geographic and engineering data among AF base organizations including BCE and emergency managers. Software and data structures for processing and exchanging geographic and engineering data will be designed and implemented. Software for creating digital databases in compatible data structures and formats will be developed for exchange of information from multiple sources to multiple users in the context of emergency management and response. This task will facilitate the processing of BCP digital databases into HMIMS files.

For one selected AF base, prototype digital databases characterizing the location of major facilities (buildings, selected utility lines, and selected emergency resources) and the interior floor plans of selected buildings will be developed. It is anticipated that the AF bases will have TAB series maps already available in digital form as part of a BCP. Chemical inventories will be acquired from AF sources. At the conclusion of this effort, one HMIMS work station with appropriate software and databases will remain at the selected AF base for continuous testing.

HMIMS will provide a user-friendly interface through menus, commands, and user-defined macros. Experience has shown that novice users and many users unfamiliar with computer programming often prefer menus, while experienced users often prefer direct commands and macros. HMIMS will offer both options to accommodate a full range of users from trainees to senior managers to experienced computer personnel. Many commands will be reduced to a single stroke via function keys. Menus will be addressable by keyboard, mouse, and/or digitizing tablet. All HMIMS databases will be accessible directly from the front menu regardless of scale and resolution.

HMIMS will provide user access to chemical information through stock numbers, building numbers, room numbers, and spatial coordinates. Spatial coordinates will be addressable through the keyboard or by cursor placement through digitizing tablet, mouse, and/or keyboard. Typical data sources will include MSDS, HAZMAT databases, and AFB inventories. Chemicals will be listed in order by NEPA codes. Access

to CDROM disks will be facilitated. HMIMS will access information directly from floppy disks containing chemical inventories for specific shops and storage areas.

Instructions will be entered into the HMIMS database for recall and display during hazardous chemical incidents and fires. These guidelines will address all types of incidents in a generic fashion. Initially the instructions will be entered by the contractor, but provisions will be made for emergency management personnel to revise at their discretion.

HMIMS will include one or more models for estimating the dispersion of airborne releases. The model will be designed to facilitate incorporation of meteorological data and data describing the characteristics of the release.

The capability will be provided to indicate any location on a given map by X,Y coordinate and draw one or more polygons related to that location. From the user's perspective, these polygons may represent zones associated with emergency management, such as cordons, levels of risk, or plumes. They may be defined as geometric shapes (circles, rectangles, etc.) or as isolines or isopleths associated with an array of data values. The geometric patterns may be generated by the plume model or entered from exogenous sources.

HMIMS will be designed to facilitate access to lists of chemical stores by location (Building and Room or X,Y coordinate) and by chemical name. Once a fire or other hazard has been located, it will be possible to identify chemicals stored in the room or in proximity to the room (same floor, other floors, same building, other buildings). Proximity may be defined as a circle of specified radius or as a user specified polygon.

HMIMS will provide the capability for exchange of data files between the system and the existing Work Information Management System.

HMIMS will be able to rapidly enter lists of chemicals in transit, such as explosives and other HAZMATs carried on aircraft, by location and chemical name. Once entered, the lists will be accessible for rapid recall and display. All lists will be archived automatically for future reference.

As an integral part of this development, it will be necessary to acquire and assemble prototype hardware systems. All systems will be tested first at ORNL and later at the selected AF bases. Project personnel will conduct one or two demonstrations of each for AF personnel at the selected AFB.

Documentation and guidance will be provided suitable for users who are not computer programming specialists. Documentation for selected commercial software will be incorporated into the overall documentation to comprise a consistent set of user instructions and information.

Through a combination of existing software, it will be possible to develop a functional system to meet AF emergency management needs. Some incremental development is necessary, but the final product will give AF fire departments improved HAZMAT data and information management capabilities.

SECTION VI

CONCLUSIONS

The following conclusions were reached for this study.

1. A real need exists for a computerized up-to-date HAZMAT inventory list that provides information on location and usage/storage amount of HAZMATs. Such a list needs to be provided to the emergency personnel as well as to other AF directorates.
2. Because the AF presently does not have a comprehensive computerized tracking system for HAZMATs, it is not possible to track HAZMATs on a day-to-day basis from their entrance to a base and through transportation, storage, and usage until removal from the installation or disposal, as appropriate.
3. The provision of either inventory information or a complete tracking system will require AF agencies outside the fire department to modify procedures and/or to implement new policies. Some of these changes can result from good-faith efforts to assist the fire department. However, effective and efficient changes would best derive from upper-level policy decisions accompanied by implementation directives.
4. The provision of a computerized HMIS will be of significant benefit to the fire department. A number of bases are trying to develop such computer systems to facilitate their response. Presently the best information source available is the DOT HMIS. This system is available on microfiche, on-line computer systems, and on CDROMs, and it is updated continuously. During an incident when a name or stock number of a released material is determined, information can be retrieved from the HMIS.

For efficiency, some degree of consistency needs to be present from base to base in terms of computer compatibility, the use of computer-aided inventory control, and the use of computer-aided HAZMATs incident control. Although there are many common needs, distinct differences occur in HAZMAT requirements because of the variation in each AF base's mission. Therefore, it would appear that the development and implementation of an HMIS for use AF-wide should also be accompanied by a predetermined degree of flexibility.

5. Site visits revealed that fire chiefs recognized the role of the fire department in HAZMAT incidents, and they are actively seeking solutions to HAZMAT problems in which they are involved. All fire chiefs visited strongly agreed on the need for computerized HAZMAT information assistance and computerized HAZMAT incident management to assist them in their work.

6. Fire departments are not active participants in the IRP planning/contracting process. As more and more bases move into Phases III and IV of the IRP, potential for IRP-related mishaps will increase. An interface with the fire department will be essential.
7. At present, no specific system is available by which the fire chief can track HAZMATs being transported in and out of the AF base. As a first respondent, the fire chief would benefit from such information. In principle CMOS may allow for such transmission of information in the future. This system is conceptual now but is targeted for 1989-1990 usage.
8. With respect to the fire department, the value of the AF hazard classification code (IEX) is unclear. In an emergency situation where, for example, only a form DD 1348-1 was accessible, the IEX code would be the only hazard classification immediately available. If the code in this situation is IEX-9, the potential range of toxicity is so great that unless other information is known, the highest level of protection must be employed. Thus, the first dilemma facing the fire department is the lack of specificity in the present system. Also, there is no AF-wide procedure for scoring chemicals according to hazard class. Thus, depending on those individuals responsible for classification, one base could be consistently classifying materials higher or lower than other bases. A further implication is that materials may change classifications over a period of time at the same base. Such a system is too inconsistent.
9. The fire department's responsibilities during HAZMAT emergencies appear to be oriented toward providing on-scene command and control, onsite rescue, fire extinguishment, and stabilization of the HAZMATs. Recovery, cleanup, and disposition of the HAZMATs are accomplished by other agencies. Some AF bases seem to be further along than others in the planning and preparation for HAZMATs incident response. Each of the bases visited identified a HAZMATs emergency response team. The fire department plays a primary role on this team, and the team consist of many types of people with assorted backgrounds. The makeup of the response team varies across the sites investigated and by the needs of a particular incident. Roles and responsibilities have been determined and assigned to the team members. All bases have SPR and DPO plans and committees that have planning as a mission for HAZMATs incident response. Some bases have also developed detailed procedures for their response to emergencies.
10. A proposes three-part incident evaluation process has management and training benefits when individual workers submit narrative reports, supervisors summarize the group activities and evaluate the performance of subordinates, and agency action narratives are prepared from individual and supervisors' reports, along with perceived problems and solutions. The agency report is checked by an agency and an environmental planning office representative for

conformance to format, completeness, clarity, and accuracy. An Incident Review Board then synthesizes the various agency reports into an overall report, integrating the inputs and proposed changes of all the agencies into a systematic report. The Incident Review Board promulgates changes to the HAZMAT response system and reviews the SPR and Hazardous Waste Management plans for needed changes. It produces a summary report of the incident, including a description of what happened, what was done, what changes were required, and what changes were made. These reports are sent to a central office for review and, if warranted, disseminated.

11. Both AF and general public pressures (regulations) are putting more demand on fire protection personnel with regard to HAZMAT incidents. In spite of added training and knowledge requirements, little or no changes have been made in job classification or expansion in personnel level. A general observation is that many agents wish to implement some element of a comprehensive inventory system or HAZMATs management program, yet usually new duties are assigned as "additional duty." The inclusion of an EMD will greatly assist any staff doing this additional duty.
12. Some considerations need to be made in assessing the use of the base weather station in HAZMAT incidents. An important consideration in having the HAZMAT response capability housed within the fire department is the presence of a 24-hour staff. While most incidents probably occur during the normal work day, such cannot be guaranteed. If the base weather station remained staffed 24-hours a day, there would be a reduced need for the fire chief to have a separate model. However, for bases at which no major flying mission is present, the weather station is not staffed around the clock, the fire chief or any other first respondent may have to make use of the HMIS plume model. Secondly, field conditions at any given base may vary considerably from point to point, depending on how much the surface conditions influence prevailing wind patterns. Gathering these data would require several meteorological towers at each base or, at a minimum, a source of on-line data from at least one tower. A portable station would be necessary for those bases where a meteorological tower is too far from the incident scene to provide meaningful data.
13. Accurate, up-to-date information on stored chemicals and waste chemicals is necessary to enable proper selection of treatment chemicals and equipment for base HAZMAT events. Even in emergency situations, consideration must be given to the long-term effects that can result from the selection of treatment chemicals. This can be accomplished only by detailed preplanning.
14. Advance planning for the purpose of chemical protective clothing selection should include a review of past HAZMAT spills/incidents. Records should be analyzed by each base to determine where spills occurred most often and what types of chemicals and volumes were typically involved. This information and a base-specific HAZMAT

inventory list are necessary to determine appropriate types of chemical protective clothing and personal protective equipment that may be needed by the fire department.

15. At present, very few HAZMAT courses are taught in the Armed Forces and there is no systematic certification of HAZMAT responders. The lack of courses means that each station essentially must develop its own program, depending on a melding of federal, state, fire department, university, and locally developed courses, with little consistency in these programs from station to station and with cost an almost random outcome. Both the cost-effectiveness of these programs and the qualifications of the trainees are problematic, having never, to our knowledge, been addressed. This lack of coherence might subject the AF to operational loss of personnel, with attendance compromise of mission and to liability. The cost of one liability suit could outweigh the cost of developing a sound, standardized program.
16. A great many HAZMAT programs and courses are available outside the military, ranging from federal to state, to local government, to colleges and university, to associations and institutes, and to commercial firms. These offerings run the gamut of the HAZMAT field from basic academic skills to the most advanced practical skills.
17. Investment in preventive measures and protection equipment are necessary and cost-effective. Spill cleanup and disposal costs are usually the most expensive elements of a HAZMAT incident. These costs can be measured both in terms of dollars and the perception of federal, state, and local agencies on the capabilities of AF HAZMAT response personnel to deal with spill emergencies.
18. The training course outline and the certification criteria prepared for this project provide a baseline for the development of a more comprehensive AF HAZMAT training program for fire departments.
19. There is a need to include a HAZMAT management chapter in AFR 92-1 to provide direction and consistency to AF fire departments.
20. Fire departments need a complete logging of HAZMAT spills on a computerized database to develop historical data, to file incident reports, to select protective clothing, and to make management decisions.
21. A compilation of environmental regulations (federal and AF) impacting AF fire departments is needed and should be available in the fire department library.

SECTION VII

RECOMMENDATIONS

The following recommendations are offered for AF considerations.

1. Provide all fire departments with the computerized HMIS software and develop AF-wide policy and operational recommendations for its successful implementation.
2. Develop HQ-level policy on a HAZMAT inventory system. This is vital to the success of a fully functional HMIS.

Many AF organizations are pursuing the development of HAZMAT inventories. At the beginning of a process, this type of plurality may be beneficial since a variety of ideas can be explored in parallel. However, after a few years development, it should be possible to narrow the alternatives and choose an AF-wide system.

3. Recommend the BEE or another AF organization to develop and maintain an AF inventory system. Of the variety of agencies that need base-wide HAZMAT inventories, the fire department is the one least responsible for developing such an inventory. Yet because of questions involving firefighter/employee safety, the fire department is often the most aggressive in pursuit of such a goal. It is more reasonable, by virtue of tasking and expertise, that the fire department be an inventory user.
4. Another important inclusion in an HQ-level directive would be that related to the maintenance of up-to-date inventory data. The supply function is the appropriate agency for initial input. Different bases have different organizations designed to provide the supply function to host and tenant organizations. To effect the development of a comprehensive HAZMAT inventory, it will be necessary to have input from supply and users at shops.
5. Establish a life cycle system that tracks HAZMATs from the time they enter the base until the time of their disposal. To establish such a life-cycle system, it is recommended that the AF study the feasibility of obtaining a generic computer system that can interface different HAZMAT-related agencies.
6. Adopt a uniform health hazard classification system to remedy the disparity of the AF hazard classification code (IEX) variability. Such system should:
 - (1) meet industrial hygiene needs;
 - (2) meet the fire department's needs;

- (3) have widespread adoption or can be implemented uniformly;
- (4) provide information consistent with AF and federal Hazard Communication Standards for occupational personnel; and
- (5) provide information consistent with Title III, Emergency Planning and Community Right-to-Know under the provisions of SARA.

The newly developed relative potency method (Reference 3) be given consideration as the basis of a health hazard classification scheme and that this potency ranking method be combined with the NFPA system to provide other necessary information for HAZMAT responses.

- 7. Add a separate chapter to AFR 92-1 for HAZMAT incident management at AF fire departments. The fundamental document defining the Fire Protection Program (AFR 92-1) is nearly silent regarding specifics of HAZMAT-related matters. This chapter would define responsibilities and list references of specific detailed taskings outlined in regulations and operational plans and would identify minimum type of equipment that must be readily available.

In addition, Chapters 1 to 11 of AFR 92-1 should be reviewed and modified to reflect HAZMAT-related AF policies as well as the most recent EPA and OSHA regulations.

- 8. Call the BEE to the site of any HAZMAT-related incident. The fire chief determines whether to mobilize the DRG and what initial steps must be taken to stabilize the incident. However, the BEE is the action agency responsible for providing toxicological assistance and must be called to incidents simultaneously with the fire department. At most installations, emergency calls go simultaneously to the fire protection, security, and medical. The BEE should receive all emergency calls and respond to the incident site, simultaneously, with the fire protection.
- 9. Evaluate the merits of performing a comprehensive, HQ-level systems analysis of HAZMAT management. Implementation of the various headquarters-, command-, and base-level taskings related to HAZMATs must be coordinated among user groups. Each user group (i.e., Base Supply, BEE, FD, etc.) has specific requirements and constraints, and these aspects must be considered during a systems analysis of information needs. Systems analyses may be carried out at any or all of the levels - base, command, or HQ. There may be unique features that separate the needs of different commands or bases. If so, then comprehensive materials management strategies should be developed for adoption at the base or command level.

In allowing each base to develop its own HAZMAT management system, the following aspects should be considered: (1) need for efficient use of resources, (2) need for parallel information across units of organization, and (3) need for assurance of compliance with all applicable regulations and with new ones as they are developed.

10. Adopt DOT regulations for on-base motor vehicle transport of HAZMATs. Random exercises should be conducted to test the communication lines between the Base Supply and the first respondent, identify contents of a chemical delivery, and determine if the resources available to the first respondent are sufficient. With the exception of intrabase transportation and special cases of off-base ground transportation entirely by AF equipment and personnel, DOT regulations provide for the timely acquisition of information needed by a first respondent. Shipments within the base should be placarded and shipping papers should be designed to give a first respondent information to assess and stabilize HAZMAT incidents involving the carrier. This provision would require a modification of the present protocol, which is tied to form DD 1348-1.
11. The fire chief should be a member of the Environmental Protection Committee and/or on any other base council that addresses Installation Restoration Program contracts. Installation Restoration Program contracts should include formal interface between the fire department and Installation Restoration Program contracting and planning. Coordination between the fire department and the onsite Installation Restoration Program manager is essential. When various organizations are briefed on specific IRP actions, this information should also be made available to the fire department.
12. Modify DOD form 2324, Fire Incident Report, to include HAZMAT incidents. This report must include records on the type of spilled HAZMAT; size, time, location, and cause of spill; damage incurred due to HAZMAT incidents; and actions taken by the fire department. Each base fire department should develop a computer database containing this type of information (MAC Fire Protection has such a database). These data should later be evaluated for management and recordkeeping purposes and developing historical data. To that end copies of the incident report should be forwarded to the Office of the Inspector General.
13. Conduct thorough self-evaluation of major multiagency response to HAZMAT incidents. Evaluation checklists presented here provide the database to accommodate the AF decisions in formalizing HAZMAT program (e.g., different agencies may be responsible for some more tasks than the way they are assigned here, and the HAZMAT program implemented may be more or less elaborate than that outlined in this project). It will require modification by user agencies to reflect local requirements and constraints.

As proposed, the evaluation process is thorough, but also time- and resource-consuming. The full process of evaluation should be limited to major, multiagency response incidents, with a more informal evaluation process carried out for minor incidents, to avoid overburdening the system with costly and time-consuming paperwork. Too, the potential value of lessons learned should serve as a criterion for expanding the evaluation process. If the incident is minor, chances are there will be little to be

learned. Another criterion might be whether major reporting requirements to other federal agencies have been triggered. All three criteria should be considered in deciding whether to undergo the full formal evaluation process. For any incident, an initial report should be submitted on a HAZMAT Incident Report form modified or included in DD form 2324, DOD Fire Incident Report.

14. Adopt the EPA standards for protective clothing Levels A, B, C, and D for the AF. Levels of protective clothing listed in AF documents with Levels I, II, and III should be translated into the language of EPA's protective clothing (Levels A, B, C, and D) for common understanding and uniformity.
15. Disposable and limited-use chemical protective suits should not be used alone for Level A protection. However, recent developments in polymer chemistry, as discussed in this report, are likely to change this situation. At this time, the safest and least expensive ensemble for situations involving unknown chemicals is a reusable, totally encapsulating, positive-pressure suit, incorporating a cover garment composed of SARANEX-TYVEK[®] or CHEMREL[®] fabric. Advantages of this ensemble are: increased total chemical protection for the responder, protection of the more expensive FES from direct contact with the chemical environment, and cost-effectiveness. Based on the "spill incident environment," a disposable suit may provide sufficient chemical protection for the responder without requiring the use of a more expensive FES. Because of their light weight, greater comfort, reduced heat stress, and cost-effectiveness, disposable suits are desirable.
16. The following recommendations refer to EPA's levels of protection - Levels A, B, C, D. If it is assumed that an incident requiring Level 4 protection occurs, each responder should have at least one complete outfit as listed in Appendix B, Table B.1. Additionally, there should be at least one spare cooling vest and air tank (for recharging and/or refilling) for each responder. At least three changes of single-use items such as gloves and underwear should be stocked.

For Level B, C, and D incidents, the key factors in determining the recommended inventory are the likelihood of the occurrence of the incident, the probable duration of the incident, and the number of responders. Generally, it is assumed that events contained internal to the base would not exceed 2-days duration. Therefore, sufficient CPC should be stocked to support two shifts of response. At least 12 units of all single-use items (from Appendix B, Tables B.2, B.3, B.4) should be available.

Financial or other constraints may make it necessary to maintain a minimum inventory of CPC but provide protection to responders. If this be the case, CPC from Appendix B, Table B.1 (Level A CPC) may "double" for a Level B, C, or D response and Level B chemical protective clothing may be used for a Level C or D response and so on

but not vice versa. Several problems exist with trying to minimize CPC inventory in this manner. Generally, the higher the level of protection provided, the heavier, the bulkier, the hotter, and the more expensive the CPC. In the final analysis, the potential cost to maintain a "bare minimum" inventory of CPC could be more than that to stock appropriate equipment for each level of response.

17. If existing FES materials on the market are not satisfactory in responding to AF-specific chemicals, the AF might consider researching and developing a suit material with desired chemical resistance. This type of "universal suit" material should also be strong enough to keep its integrity under fire and decontamination procedures.
18. Develop a medical monitoring system for response personnel in addition to routine physicals. The cumulative, long-term effects of exposures to HAZMAT, even for personnel in protective clothing, is unknown.
19. Conduct further detailed study and demonstration on decontamination and disposal methods for protective clothing. The base-level fire departments lack the information necessary for the proper decontamination and disposal of protective clothing. Practical, step-by-step procedures should identify how and where the fire department can decontaminate and dispose of protective clothing. Costs, benefits, and performance comparisons must be made between disposable protective clothing and nondisposable protective clothing. Developed procedures need to be tested and validated before they are implemented.
20. Utilize base supported toxic corridor models provided by the Air Weather Service during incidents. Except in unusual circumstances, only single meteorological towers are anticipated at AF bases. At some bases, the location of instrumentation for the base weather service is such that the meteorological data are representative of the whole base. Other bases may have widely varying conditions from location to location on base, particularly during certain times of the day when heating or cooling effects are important. If sufficient variation is present on a given site and/or the base weather service is not present around the clock, meteorological data taken at the incident site may be critical. It would then be necessary to have a portable meteorological station for a portable HMIS system. The decision as to whether a portable station is required would be site-specific based on the number and locations of meteorological towers, support by weather service, the diversity of conditions within the base, the potential to be called off base, and the calculational support provided by the weather service.
21. Clearly, do not make evacuation decisions on the basis of a computer model alone. Decisions of this nature require the considerations of the Base Commander and the experience represented by groups in DRG. As such, results of a toxic corridor computer model can provide one aspect of the information-gathering process.

22. Validate and verify the personnel evacuation criteria and the checklist for personnel evacuation decision-making. Various task elements and procedures identified in regard to HAZMAT personnel in this report should be field tested at a number of AF bases during actual HAZMAT emergencies.
23. Recommend that added responsibilities for the fire department be accompanied by increased equipment and staff. Three full-time positions per shift should be created within each base fire department, and the duties assigned to these firefighters should be specifically related to HAZMAT spill response.
24. Each AF base fire department should be issued a vehicle/van for use in response to HAZMAT incidents. At the large bases with diverse missions, a large van/motor home specifically configured for HAZMAT response is required. This vehicle, approximately 40 feet or larger, must contain the equipment necessary to initially mitigate HAZMAT spills, leaks, or releases, while providing command, control, and communications at the site of HAZMAT emergencies. This vehicle should have the capacity for future growth and development since the role of the first-responder is still being defined. Immediate considerations are space for suits, generators, lights, diking materials, absorbents, DECON, cold weather operations, computer, and crew transportation.
25. Incorporate HAZMAT training into a specifically developed, AF unique, training course based as much as possible on NFA, FEMA, EPA, and NFPA courses. This would be cost-effective and apply to AF equipment, command structures, facilities, and HAZMATs than would be off-the-shelf programs. As a minimum, this training should conform to NFPA standards for certification of HAZMAT responders but should be carefully tailored to AF needs. Some of this training might be standardized for all personnel, such as the basic knowledge courses and training on equipment and those HAZMATs found throughout the AF. Other courses, such as specialized task training using equipment not widely used in all units, might need to be developed for individual response units. Core courses and advanced courses for which specially qualified instructors or special equipment are needed should be taught at the AF Fire School. However, as much as possible, coursework required for a higher level of certification should be made available at local bases and should be used in part to fulfill continuing training requirements. The AF HAZMAT training should be accredited by the Community College of the Air Force. This criterion would subject the training to another level of professional evaluation and add incentive value to becoming trained in HAZMAT response.
26. All fire protection personnel, along with others who might play support roles in a response, should be trained to the First Responder, Awareness level as mandated by federal regulations. Beyond that, a career ladder program in HAZMAT might be considered, with some fire protection personnel specializing in HAZMAT.

27. Determine whether to have a full-scale response unit at every base or to have basic competency (perhaps one or more HMSs at each base, with support personnel and equipment to handle small- and medium-sized spills) at each base with regional response teams strategically located for fast response wherever needed.
28. AF fire departments should be provided with a 100 to 150 page handbook containing environmental regulations relevant and necessary to their response activities. This condensed version could be prepared and distributed at Air Staff level to all potential users.
29. The HMIS software and hardware should be updated periodically to maintain a state-of-the-art system. Some of the future improvements could be:
 1. A development of a priority list of chemicals based on hazard potential at certain locations. Such a list would provide a quick recognition of the magnitude of risk among toxic materials, providing reduction in health risks from exposure to HAZMATs.
 2. Ruggedized equipment for mobile HMIS and enhance telecommunications. This system would improve interface with alarm room, command post, and remote operations, while providing onsite access to HAZMAT information.
 3. Videotape access for building interiors; this capability would provide a quick visual access to HAZMAT locations, utility boxes, exits, etc., under emergency and nonemergency conditions for personnel in the Alarm Center and onboard HAZMAT vehicles.

REFERENCES

1. Federal Register 52 FR 31877, "Hazard Communication Standard of the OSHA," August 24, 1987.
2. U.S. Department of Transportation, Emergency Response Guidebook, Washington, D.C., 1984.
3. Jones, T. D., Walsh, P.J., Watson, A.P., Owen, B. A., Barnthouse, L. W., and Sanders, D. A., "Chemical Scoring by a Rapid Screening of Hazard (RASH) Method," Risk Analysis, vol 8(1), pp. 99-118, 1988.
4. Engineering-Science, Inc., Guidance Manual for the Preparation of Spill Response Plans, Air Force Engineering and Services Center, Tyndall Air Force Base, Fla., January 1983.
5. Hildebrand, M. S., Noll, G. G., and Yvora, J., "Methodology for Emergency Management of HAZMAT Accidents," Proceedings of the National Response Teams, 8th Hazardous Materials Spills Conference, pp. 79-83, 1986.
6. U.S. Coast Guard, Chemical Hazards Response Information System (CHRIS), vols 1-4, Department of Transportation, November 1984.
7. National Institute of Occupational Safety and Health, Pocket Guide to Chemical Hazards, Government Printing Office, Washington, D.C., 1980.
8. American Association of Railroads, Bureau of Explosives, Emergency Handling of Hazardous Materials in Surface Transportation, Washington, D.C., 1986.
9. National Fire Protection Association, Fire Protection Guide on Hazardous Materials, 7th ed., 1981.
10. Environmental Protection Agency, Chemical Emergency Preparedness Program, Interim Guide, Rev. 1, 9223.O-1A., Washington, D.C., 1985.
11. Sax, N. I., Dangerous Properties of Industrial Materials, Van Nostrand Reinhold Co., 6th ed., Government Institute, Inc., 1984.
12. Hawley, G. G., The Condensed Chemical Dictionary, Van Nostrand Reinhold Co., 10th ed., New York, N. Y., 1981.
13. Kemmerlowe, David L., "Computer-Aided Management of Emergency Operations," The International Fire Chief, pp. 12-15, January 1987.
14. National Oceanic and Atmospheric Administration, Computer-Aided Management of Emergency Operations, Seattle, Wash., 1987.

15. Chanute Air Force Base, Technical Training Center, "Munition Hazardous Materials Firefighting," Fire Protection Training, Course No. c3AZR57150 001, November 1986.
16. Environmental Protection Agency, Site Specific Technical Guidance for Hazards Analysis: Emergency Planning for Extremely Hazardous Substances, Washington, D.C., July 1987.
17. Sorensen, J. H., Vogt, B. M., and Mileti, D. S., Evaluation: An Assessment of Planning and Research, ORNL-6376, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1987.
18. ICF Incorporated, Feasibility Study and Cost Benefit Analysis for the Development of A Computerized Emergency Response System for Releases of Hypergolic Propellants (Contract No. F04701-86-C-004), Washington, D.C., 1986.
19. National Institute for Occupational Safety and Health, Occupational Safety and Health Administration, U.S. Coast Guard, and Environmental Protection Agency, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS (NIOSH 85-115). Government Printing Office, Washington, D. C., 1985.
20. Levy, K. D., and Carr, M. W., "Site Entry Procedures for Hazardous Material Incident Response." In: Association of American Railroads, Bureau of Explosives, Proceedings of the 1982 Hazardous Materials Spills Conference, Rockville, Md., Government Institutes, Inc., 1982.
21. Perkins, J. L., "Chemical protective clothing: I. Selection and Use." Applied Industrial Hygiene vol 2(6), pp. 222-230, 1987.
22. Schwabe, A. D., Costas, P. P., Jackson, J. O., and Weitzman, D. J., Guidelines for the Selection of Chemical Protective Clothing, 2nd ed., Cincinnati, Ohio, American Conference of Governmental Industrial Hygienists, Inc., 1985.
23. Ronk, R. M., White, M. K., and Linn, H., Personal protective equipment for hazardous materials incidents: A selection guide. 2nd ed., Cincinnati, Ohio, American Conference of Governmental Industrial Hygienists, Inc., 1984.
24. Rodgers, S. J., "How to Select and Use Personal Protective Garments," Industrial Safety and Hygiene News, vol 11, September 1988.
25. Fosberg, K., Chemical Permeation and Degradation Data Base and Selection Guide for Resistant Protective Materials, version 1.0, Austin, Tex. (Instant Reference Sources).
26. Coydan, R., Schwabe, A., and Lloyd, S., CPC Base, version 1.0, Arthur D. Little, Cambridge, Mass., 1986.

27. Hensley, E., "Personal Cooling: Preventing Heat Stress in Chemical Protective Clothing." Hazardous Materials and Waste Management Magazine, September-October 1987.
28. Perkins, J. L., "Chemical Protective Clothing: II. Program Considerations." Applied Industrial Hygiene, vol 3(1), pp. 1-4, 1988.
29. Garland, C. E., L. E. Goldstein, and C. Cary, "Testing fully encapsulating suits in a simulated work environment." Performance of protective clothing, ed., R. Barker and G. C. Coletta. ASTM, Philadelphia, Penn.
30. MSA Research Corp., Material Development Study for a Hazardous Chemical Protective Clothing Outfit, Report No. CG-D-58-80, August 1980.
31. "A Discussion: Resistance of Butyl Rubber Gloves to the Penetration of Aromatic Nitro and Amino Compounds," American Industrial Hygiene Association Journal, vol 39, pp. 314-316, 1978.
32. Middleton, H. W., Glove Corrosive Liquid Immersion and Permeability Study, No. GEPP-322. General Electric Co., Neutron Devices Dept., St. Petersburg, Fla.
33. Nelson, G. O., and Wong, C. M., "Glove Permeation by Organic Solvents," American Industrial Hygiene Association Journal, vol 42, pp. 217-225, 1981.
34. Sansome, E. B., and Tewari, U. B., "The Permeability of Laboratory Gloves to Selected Solvents," American Industrial Hygiene Association Journal, vol 39, pp. 164-174, 1978.
35. Williams, J. R., "Permeation of Glove Materials by Physiologically Harmful Chemicals," American Industrial Hygiene Association Journal, vol 40, pp. 877-882, 1979.
36. ASTM Committee, "Guidelines for the Use of Foam for Vapor Control of Hazardous Materials," Hazardous Materials and Oil Spill Response, 1988.
37. Norman, E. C., "A Guide to the Use of Foam on Hazardous Materials Spills," Hazardous Materials and Waste Management Magazine, September-October, pp. 24-26, 1987.
38. Godfrey, K. A., Jr., "Foam over troubled toxics," Civil Engineering, pp. 46-48, February 1988.
39. EPA, "Handbook for Using Foams to Control Vapors from Hazardous Spills," Hazardous Waste Engineering Research Laboratory, Cincinnati, Ohio, 1985.

40. Fire Service Directory of Training and Information Services,
Specialized Publication Services, New York, N.Y., 1987.
41. Federal Emergency Management Agency, Digest of Federal Training in
Hazardous Materials, FEMA 134, Washington, D.C., July 1987.

BIBLIOGRAPHY

A Proposed Medical Protection Plan for the Phoenix Fire Department's HAZMAT Response Team, The Medical Toxicology Department of St. Luke's Medical Center, Phoenix, Ariz.

Chemfab Technical Report, No. 3-1186.01. Durafab - Division of Texel Industries, Inc., Cleburne, Tex., Nov. 1986.

Chemical Emergency Preparedness Program, Revision 1, 92230.0-1A, U.S. Environmental Protection Agency, Washington, D.C., Nov. 1985.

Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety, Cambridge Systematics, Inc., Cambridge, Mass., Contract DTRS5681.C.00042, May 1983.

Computer Aided Dispatch and Mobile Digital Terminal System Report, Phoenix Fire Department, Phoenix, Ariz., April 1987.

Computerized Spill Response Catches On, U.S. Department of Transportation, United States Coast Guard, Feb. 1984.

Control and Issue of Health Hazardous Items, Department of the Air Force, Oklahoma City Air Logistics Center, Tinker AFB, Okla., OC.ALC.TAFB Regulation 67.14.

Development of an Atmospheric Diffusion Model for Toxic Chemical Releases, AFGL.TR.85.0338, Atmospheric Sciences Division, Air Force Geophysics Laboratory, Hanscom AFB, Dec. 20, 1985.

Disaster Preparedness, Planning and Operations, AF Regulation 355.1, Department of the Air Force, Washington D.C., Dec. 14, 1983.

Durafab Hazard/Guards, Products for Chemical Protective Clothing, Durafab - Division of Texel Industries, Inc., Cleburne, Tex.

Emergency Management Division, General Services Agency, County of Orange - Hazardous Materials Incident Response Plan, County of Orange, Calif., Jan. 1982.

"Emergency Planning and Community Right to Know Act," Title III of SARA, Public Law 99-499, Oct. 17, 1986 (40 CFR 300).

Emergency Situation Response Plan, The University of Texas Health Science Center at Houston, Houston, Tex., Aug. 1978.

Executive Order 12088, "Federal Compliance with Pollution Control Standards," October 13, 1978.

Exemplary Practices in Emergency Management: San Mateo County California Hazardous Materials Response Plan and Hazardous Materials Response Unit, FEMA 119, Federal Emergency Management Agency, National Emergency Training Center, Emergency Management Institute, Feb. 1987.

Feasibility Study and Cost Benefit Analysis for the Development of a Computerized Emergency Response System for Releases of Hypergolic Propellants. U.S. Environmental Protection Agency, Washington, D.C., Sept. 26, 1986.

Federal Emergency Management Agency, Digest of Federal Training in Hazardous Materials, FEMA 134, Washington, D.C., July 1987.

Federal Emergency Management Agency, Emergency Management Institute, Digest of Federal Training in Hazardous Materials, 1988-89, Washington, D.C.

Federal Emergency Management Agency, National Fire Academy - National Emergency Training Center, Hazardous Materials, Incident Analysis, NFA-SM-HMIA/TiT, February 1, 1985.

"Fire Communications Center Operator Functions." 1776 ABW/DEFO.C, Andrews Air Force Base, Md., Dec. 15, 1986.

Fire, Frank L., "Handling Hazardous Materials Incidents - An Emergency Guide," Part 2, Fire Engineering, March 1985.

Fire Protection Hazardous Material Incident Involvement. Department of the Air Force, Headquarters United States Air Force, Washington, D.C., Dec. 1987.

Genesis Project - Project Development Schedule. 2854th CES/DEF, Tinker Air Force Base Fire Department, Okla.

Guidance for Developing State and Local Radiological Emergency Response Plans and Preparedness for Transportation Accidents, Federal Emergency Management Agency, FEMA.REP.5, Mar. 1983.

Hanscom AFB "Hazardous Materials," Hanscom AFB, Mass., June 1987.

Hazard Communication, Occupational Safety and Health Standard by OSHA, 29 CFR 1910.1200, November 29, 1983.

Hazard Assessment Computer System (HACS). International Association of Fire Chief, Inc., Washington, D. C., Hazardous Materials Emergency Planning Guide. National Response Team. Washington, D.C. 20593, March 17, 1987.

"Hazardous Incident Response Team," Montgomery County, Chevy Chase, Md., 1985.

Hazardous Material/Chemical Incidents, Fire Protection Branch, Civil Engineering Division, Operating Instruction A.16, Tinker Air Force Base, Okla., Nov. 22, 1987.

Hazardous Materials Spill and Leak Control Course, American Society of Safety Engineers and The Society of Fire Protection Engineers, April 1986.

Hazardous Material Spills Conference Proceedings. Association of American Railroads, United States Coast Guard, Chemical Manufacturers Association, United States Environmental Protection Agency, St. Louis, Mo., May 5-8, 1986.

"Hazardous Materials Response Team," Pinellas Park, Fla., June 1986.

Hazardous Waste Operations and Emergency Response, OSHA rule 29 CFR 1910.120, Dec. 1986.

"Hexxis System." Hexxis, Inc., Dallas, Tex., 1986.

Houston Fire Department, "Guidelines and Procedures for Hazardous Materials Emergencies," SP-8, Houston, Tex., 1982.

Lessons Learned. U.S. Department of Transportation, U.S. Environmental Protection Agency, Washington, D.C., Dec. 1985.

Mayhew, Joe C., "A Giant Step for Hazardous Materials Response," The International Fire Chief, vol 529(11), Nov. 1986.

"Minutes - Committee on Hazardous Material Response Personnel," National Fire Protection Association, Battery March Park, Quincy, Mass., Oct. 28, 1986.

National Chemical Response and Information Center. CHEMTREC CHEMNET, Chemical Manufacturers Association, Washington, D.C., 1988.

National Fire Academy, Course Catalog 1987-1988, Federal Emergency Management Agency, National Emergency Training Center, Washington, D.C.

National Fire Academy - National Emergency Training Center, Recognizing and Identifying Hazardous Materials, NFA-SM-RIHM/TiT, Feb. 1985.

National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR 300. U.S. Environmental Protection Agency (Federal Register), vol 50, No. 224, Nov. 20, 1985.

Occupational Safety Chemical Safety, AFOSH Standard 127.68, Department of the Air Force, U.S. Air Force, Washington, D.C., Dec. 26, 1985.

Operations Manual of the Hazardous Materials Response Team, No. 86.001, Fairfax County Fire and Rescue Department General Order, Fairfax County, Va., Jan. 1987.

Orange County Fire Chief's Association, "Hazardous Materials Response System," Rev. 1-86, Orange County, Calif., March 1985.

Pendergrass, W. R., R. P. Hosker, and B. B. Hicks, Bioengineering Flow-sheet for Classifying Hazardous Materials. Tinker Air Force Base. Atmospheric Release Management and Assessment Program. Atmospheric Turbulence and Diffusion Division, National Oceanic and Atmospheric Administration, 456 South Illinois Avenue, Oak Ridge, Tenn., Aug. 18, 1986.

Phoenix Fire Department, "Hazardous Materials Standard Operating Procedures," Phoenix, Ariz., June 1982.

Product Distribution. Product D033.WEA.WD.GWE, Recipient 2854 CES. DEFT, May 11, 1987.

Proposed Hazardous Materials Program (Based on the Eight-Step Process) Air Force Fire Protection Assembled by Sgt. Phil Baker, Andrews Air Force Base, Mass., 1986.

Spill Prevention and Response Plan, OC.ALC OPLAN 19.2, Directorate of Environmental Management, Oklahoma City Air Logistics Center, Department of the Air Force, Tinker Air Force Base, Okla. 73145, Oct. 6, 1986.

"Staff Directory." Visual Aid 23.1.1, 2854th Air Base Group, Tinker Air Force Base, Okla., April 1, 1987.

Standard Operating Procedures, Pinellas County Hazardous Materials Response Team, Pinellas Park, Fla., 1985.

The Clean Air Act, Public Law 88-206, 1963.

The Clean Water Act, Public Law 95-217, Dec. 27, 1977.

The Comprehensive Environmental Response, Compensation, and Liability Act, Public Law 95-510, Dec. 11, 1980.

The Hazardous Materials Transportation Act, Public Law 93-633, Jan. 1975 (49 CFR 171-178).

The Occupational Safety and Health Act, Public Law 91-596, Dec. 29, 1970.

The Prince Georges County Fire Department, "Hazardous Materials Standard Operating Procedures," Upper Marlboro, Md., Aug. 1985.

The Resource Conservation and Recovery Act, Public Law 94-580, Oct. 21, 1976.

The Safe Drinking Water Act, Public Law 93-523, 1974.

The Superfund Amendments and Re-Authorization Act, Public Law 99-499, Oct. 17, 1986.

Trip Report, "Hazardous Materials Incident Management System Project," Bryce E. Mason, Air Force Engineering and Services Center, Feb. 26, 1987.

User's Guide to AFTOX (Air Force Toxic Chemical Dispersion Model). AFGL/LYA, Hanscom AFB, Mass., October 1986.

Vogt, B. M. and J. H. Sorenson, Evacuation in Emergencies: An Annotated Guide to Research. ORNL/TM-10277, Oak Ridge National Laboratory, Oak Ridge, Tenn., Feb. 1987.

Winco Spill Prevention, Control, and Countermeasures Plan, Cooper, S. C., K. Krivanek, R. J. Marcinkio, and R. L. Jaussi, Monograph Series No. 3, Winco -1041, Westinghouse Idaho Nuclear Company, Inc., for the Department of Energy, Idaho Operations Office, Aug. 1986.